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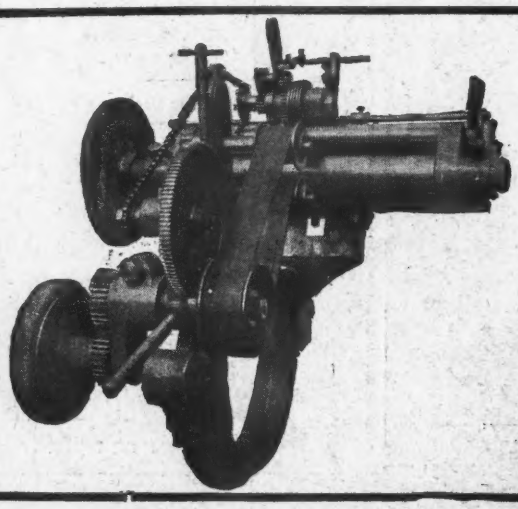

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IN view of the recent Increase in the Postal Charges, our Subscription Rates for Great Britain and Canada will until further notice be increased to £1 1s. 8d. and £1 3s. 10d. respectively.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

AT the last annual general meeting of the Institution it was suggested that greater publicity should be given to the doings of the Council and Committees. At present their proceedings are sedulously concealed until in May they are set forth in brief paragraphs in the Council's annual report. Why this practice should obtain, and whether it has any sound reasons to support it, other than the feeble excuse of long-established custom, we do not know; but we remember that the suggestion to change it was heartily welcomed, not only by the members, but also, we believe, by the then President, Sir John Snell.

In support of the proposal we may point out that the secrecy shrouding the proceedings of the Committees conceals from the members in general the activities of the members of the Committees, and thus inflicts an injustice upon the latter; it is also detrimental to the interests of the Institution, as it tends to the diffusion of distorted statements and unfounded rumours as to what is being done, and prevents the vast majority of the members from adequately appreciating the enormous amount of work that their Council and Committees in fact accomplish. Surely there is no necessity for so much mystery. At the risk of incurring the displeasure of the more dignified members—those, for example, to whom the very thought of shopkeeping is distasteful—we may cite the example of the younger body—the American I.E.E.—which prints in its *Proceedings* a report of the monthly meetings of the Board of Directors, together with personal notes, lists of the members of the various Standing and Special Committees (which number no fewer than 36), and a variety of other useful information available only to the directorate. The Institute has 32 Local Sections and 53 "Branches," and is a very live organisation indeed. The American Society of Civil Engineers practises similar methods, and so does the American Society of Mechanical Engineers; both have a membership over 6,600, and the latter has doubled its numbers during the past five years, thanks (in its own words) "to the policy of promoting the welfare of the individual engineer through the development of high ideals in the profession, and its activities in all matters of public interest—and this *without overlooking the human element*." The words which we have italicised seem to us to touch the root of the complaints which are periodically preferred against our own Institution.

To take another point, the Institution of Civil Engineers has adopted the practice of opening its meetings at 5.30 p.m; the meetings are preceded, instead of followed, by a social cup of tea or coffee, and we understand that the new arrangement is very popular with the members. We believe that a similar reform would be heartily welcomed by the members who attend the London meetings of the Institution of Electrical Engineers. It has been argued that the members of Council would then be put to inconvenience in respect of their dining arrangements, but even if so unworthy a suggestion were "taken seriously," we cannot imagine that the Council would permit its decision to be swayed by its digestive faculties rather than by the advantage of the members as a whole. People do not wish to be out late nowadays, and the closing of the meeting at 7.30 p.m. would meet their wishes. It is for the members themselves, of course, to press the matter if they approve of the proposal;

experience teaches that the Council will never move unless it is pushed.

A point on which, as a technical journal, we should like enlightenment from the Council concerns the relationship between the Institution and the International Electrotechnical Commission. The connection, apparently, is very intimate, yet the Institution, though it has published the list of symbols and abbreviations for electrical quantities which have received the sanction of all the leading nations, has not officially adopted them in its *Journal*. So far as we are aware, the only nations which consistently use the authorised notation are our Teutonic enemies, who are so inured to discipline that with them an official regulation must necessarily be complied with. But does not the Institution intend to uphold the international system? We confess that while the symbols for quantities are acceptable, we do not like some of the signs for the names of units to be employed after numerical values; for example, mA and kW for milliampere and kilowatt respectively, and kWh for kilowatt-hour—a confusion of types which, to our mind, is unsightly, as well as meaningless. There is no definite sign for the ohm, though either O or Ω is recommended—ω being used for $2\pi/T$; doubtless the context will generally show that Ω does not now mean megohm (which would be either MO or MΩ), but who would guess that μO stood for microhm? However, in spite of our objections, we will use these signs in the Electrical Review if they are given an official standing by our leading authorities.

Another matter, which may prove of more importance than any of those that we have mentioned above, is the question: What are we to do with our aliens? That there is a strong undercurrent of feeling on this matter in the membership of the Institution cannot be denied, and it is not confined to the junior ranks of the profession, very strong views indeed having been expressed by some engineers of high standing. A society consisting largely of members of the Institution addressed a request to the Council to deal with the matter, but, as we recently noted, the Council returned an evasive reply. That the Council possesses adequate powers under the existing Articles to deal with the matter will be obvious from the extract which we reprinted, but we do not anticipate that it will take action unless compelled to do so.

Our own position in the matter can readily be defined. So far as concerns the British-born descendants of alien enemies, and those of alien enemy origin who were residents of long standing and had taken out letters of naturalisation before the war, we feel that they are entitled to immunity from interference of any description; the nation has accepted them as British subjects, and is bound in honour not only to respect but also to uphold their rights and privileges. But as regards actual alien enemies, the position is very different; for them, in view of the barbarities and ferocity, the treachery and dishonourable acts, of their compatriots, we feel no sympathy whatever. A certain number of such enemies are members of the Institution of Electrical Engineers: are we worse off, or are they better off, for that fact? We do not know that it matters one iota, for the moment, whether they retain the title or not; for that matter, they call themselves men, as we do, and we cannot make them divest themselves of the title. The real question, to our mind, is: would the expulsion of our enemies from membership of the Institution serve any useful purpose, now or in the future?

That it could have no possible influence on the conduct of the war is obvious; on the other hand, an alien enemy who could pose as a member after the war might find the title of advantage in promoting trade relations with neutrals, or even with our Allies, by sailing under false colours. The most important and immediate effect of such an expurgation of the roll, however, would be an indirect one. At present members of British nationality, but of alien enemy origin, are necessarily grouped, in the eyes of the public, in the same class as the actual enemy members, and the removal of the latter would help to lighten the shadow which undoubtedly has rested upon the former. Many of our readers feel very strongly on this matter; we urge them to consider it from all points of view and in a judicial frame of mind before taking action, lest injustice be done.

Where there is no Room for Retrenchment.

We read in the newspaper Press that the Retrenchment Committee, to which has been relegated the duty of investigating the expenditure of Government Departments, had under consideration, at its last meeting, the accounts of the Board of Trade. Now we are quite prepared to believe that there are some sections of this all-important department whose staffs require shaking up in a wide-meshed sieve, and that a de-fossilising process might, by means of pensions, bring about a very wise retrenchment. We are not blind to the fact that, as a whole, the Board is an extremely complicated organisation, which over a long period of years has been adding compartment to compartment, until it has become one vast concern, though with its premises scattered here, there, and somewhere else; but, on the whole, we should say that at the present important juncture the Board of Trade is one of the last Government departments in which a reduction in expenditure can be looked for. It may be that there is certain waste taking place there as in too many other places, but it will be dangerous for a Retrenchment Committee to lop off anything here just now unless it has powers also to add something more efficient in its place. And such a privilege as that hardly seems to fall legitimately within the scope of a Retrenchment Committee. We believe it to be the conviction of the business community of the kingdom that the need of the moment is for a large increase in expenditure upon the department which is supposed to assist us in connection with our national industries and trades. The one branch of Mr. Runciman's widespreading department which has really at heart the interests of these industries is the Commercial Intelligence Branch, which has been for years poked away in Basinghall Street in miserably dull premises, as though neither it nor its staff were to be permitted to see the exhilarating light of day. It is true that since the outbreak of war other and distinctly more creditable premises have been taken for particular purposes in Cheapside, but the situation of its Basinghall Street offices—cribbed, cabined, and confined as they are—seems to us to be typical of the cribbed, cabined, and confined policy under which the Branch has to operate. Nationally we have been altogether too niggardly in our national expenditure upon trade-cultivation activities. For years we have urged the necessity for spending if need be an additional half a million sterling per annum upon bringing to a state of business efficiency our staff of Consular representatives, commercial attachés, and trade commissioners. We hope that Mr. Runciman will recognise that the good work done by the very small and inadequate number of Trade Commissioners that we have representing British interests abroad has shown that it would be a profitable national investment to appoint at least half-a-dozen or a dozen others. Their services have been appreciated by business firms, who are asking for more. Is it a fact that we have no actual trade representative watching over our affairs in Russia even now?—a market that calls for two or three. Is it not true that for so vast an expanse as Canada we have but one Trade Commissioner? What can reasonably be expected when we do things on such a scale? Of what *permanent* avail can it be to send a roving commissioner once to visit South America, or, say, China—he may issue an excellent report and answer many questions when he gets home, but these temporary or flash-in-the-pan appointments do not meet the needs of the case, and they certainly will not do so in the future. Hence we see little chance of retrenchment in connection with the Board of Trade Commercial Intelligence expenditure. Indeed, every important consideration just now calls for an increase, for not only must the Branch be enabled to continue and extend the excellent work undertaken consequent upon the war, but the Board's trade activities should be organised at home in such a way that it can intelligently deal with the requirements of different industries, and there ought to be a greatly increased staff of Trade Commissioners. Notwithstanding all the financial burdens that we have to carry at present, we believe that a substantial vote of money would be passed with practical unanimity at Westminster.

We greatly hope that such matters will not be deferred

until after the war. Mr. Runciman has told us of some things that his Department has been doing alone, and in co-operation with outside experts. He says that we shall not be found unprepared for the trade war when it comes, and if we feel that he is a little optimistic in describing Germany as already commercially beaten, it may be because he is in possession of facts concerning which we know nothing, or because he has some far-reaching scheme drawn up which will embrace the above, and some other very interesting measures, for the protection or assistance of our industries. We hope that time will prove such to be the case.

A Teutonic Miscalculation.

In all Allied countries measures are being discussed with great zest with the object of rendering the peoples of those countries independent of the Central Empires, if they still exist as such, after the war. Movements are on foot which might never have been started, and others have been revived which might have been allowed to sleep on for decades, purely because of some of the lessons learned through the experiences of the last 18 months. The "Never Again!" determination is heard in all of these discussions, and in that spirit is being laid the basis of many an important scheme. The Teutonic organisers, scientists, and industrial magnates may not have foreseen that one of the consequences of the growth of Prussian militarism and the efforts to attain its ideals (!) would be the bringing up to a higher state of efficiency of the organisations and productive facilities of the countries which had previously been the Teuton's prey, and the fuller utilisation of natural resources so as to ensure a greater measure of independence. Germany, by her very ability to conduct hostilities in the way she has done, because of her vast industrial works and organisation, and her capacity for holding out economically, has been forging in the minds of her enemies a weapon which will increase their ability to deal with her economically and prevent her commercial inroads after hostilities have ceased. Some of the movements may take long to mature or to develop into actual works rendering the service they are projected to provide; it may be years before some of them exercise any really substantial effect upon the situation. While it is impossible to conjecture what the immediate after-the-war consequences of such investigations and schemes may be, one thing is clear, that by practically compelling—unintentionally—Russia, France, Italy, and ourselves to look into such matters and devise plans and measures for increasing our efficiency for the future, Germany has made a rod for her own back—a rod which we trust will not be easily broken. What we have to see to is that these plans and schemes are not allowed to end in talk.

One measure of the kind that we have in mind hails from Italy, where the initial steps in connection with a scheme proposed for the utilisation, on a vast scale, of the water powers still remaining unemployed in Italy, are being taken in the current week at Milan, in the presence of a number of members of Parliament. At the last meeting of the Association of Electricity Supply Works, Signor E. Conti drew attention to the importance which a greater use of water powers would have in regard to the national defence, the rendering of the country independent to a great extent of supplies of coal from other nations, the extraction of iron from the ore, and the production of fertilisers. As a number of members of Parliament have expressed the desire to be specially informed on the subject, Signor Conti has arranged to give a first lecture this week, which is to represent the initiation of a crusade in favour of the development of the "white coal" resources of the country.

Lead.

There has been a remarkable outburst of strength and activity in lead during the last few weeks, the supplies coming to hand and available for disposal being quite out of proportion to the demand experienced, and the result has been a very active market at prices showing rapid appreciation. The inquiries which found the market short of material in this way came almost entirely from the hands of munition firms in this country, there having been a lull in export buying, particularly from Russia, while generally consumption has, of course, become a thing of the past. It is, indeed, reported in some quarters that there is a disposition among manufacturers of pipes and so on to resell part of their holdings of metal, owing to the enormous price appreciation, and the fact that general merchant business has come almost to a standstill. The Russian demand, which some months ago constituted the great feature of the market, has become less aggressive, and one steamer, indeed, which recently took on board between 2,000 and 3,000 tons of lead for Archangel has not sailed at all, and will probably be headed for some other port when she does clear. Supplies coming forward are by no means excessive, and so long as the freight position remains as it is, any material relief is out of the question. There are believed to be considerable stocks of metal in Spain and also in the United States awaiting steamer room to bring it to the centres of consumption, while the Mexican output is certainly increasing. There is said to be little or no scarcity of lead for forward shipment, and this although prices have been moved up in a sensational fashion under the spur of demand. It has been well said that while there is no real scarcity of lead in the world there is a very pronounced scarcity in the centres where it is most needed, and this seems pretty well to sum up the entire situation. The outlook, however, appears to indicate a continuance of high prices for a prolonged period, though it is possible there may be sharp fluctuations, especially if sellers occasionally come forward and find the market temporarily bereft of buyers.

One of these fluctuations has now developed as the result of the determination of the Ministry of Munitions to put a stop to the speculation which has been largely instrumental in bringing about the present extravagant level of values. It is the intention of the authorities to place lead under the "Defence of the Realm Act," which prohibits dealings except under permit. Official intimation to this effect has been given to the London Metal Exchange, and the result was a sharp drop in prices.

Financial Troubles at Buenos Ayres.

The financial situation of certain countries in South America was rather critical before the outbreak of the war in Europe, and the subsequent occurrence of hostilities merely served to aggravate the position of affairs in that part of the American continent. Although improvements have recently been reported to have taken place in one South American country, probably a first instance of a great city—in that part of the world—being unable to meet its payments for public lighting, has arisen in the case of Buenos Ayres, of whose development in many directions so much has been heard in recent years. According to a local newspaper, the City Council has got in arrears in its payments both for gas and electricity, so that a sum of more than $1,049,000 was owing to the Compania Primitiva de Gas in November, and $900,000 to the German Transmarine Electricity Co., of Berlin. In order to meet these payments, the City Council has approved the allocation to the gas company of bills for the amount due, having a currency of six months, and bearing interest at the rate of 6 per cent. per annum. It is stipulated that the bills can be renewed for a further term of six months, the currency of six months having been fixed so as to enable the bills to be discounted. In the case of the electricity supply company, which had instituted an action against the city, in which it was sought to secure a partial settlement of the claim by setting the taxes payable by the company to the town against the amount owed by the latter to the former, a compromise has been arranged whereby six months' bills for $900,000, bearing interest at the rate of 6 per cent. per annum, and maturing on July 31st, 1916, are to be handed to the company. In addition the account for supply in the December quarter is to be partly equalised to the amount of one-half of the taxes payable by the company in this month, whilst the remainder will be settled by bills falling due in April, but yielding no interest. This process will be continued until October, and may be extended further by mutual agreement.

OUR TRADING OPPORTUNITIES THROUGHOUT THE WORLD.

(*Continued from Vol. 77, page 795.*)

Trade with South America.

It must be particularly annoying to the export firms of the United States to find that the wonderful and long-cherished Panama Canal has "broken down" at a time when the various States of South America are so much in need of manufactures which, for reasons beyond their control, the Germans cannot supply, and which because of British manufacturing activities in connection with munitions of war, or else through lack of shipping facilities, we are at present unable to export. But, Canal or no Canal, it has for some time been the desire of the States to nurse South America commercially, and such attentions have been strikingly in evidence during these eighteen months of war. Expeditions big and expeditions small have been dispatched to cultivate relations with buyers and others there both for immediate and for ultimate advantage. There is not, however, an absolute certainty among our cousins that they will permanently hold what they now have so excellent an opportunity to gain. They have come up against the influence of European capital—and if anybody has a hold on South America on that ground British investors have. They have also come up against the hold that Teutonic influence establishes when German capital initiates a public undertaking, or buys up a British one and develops it. It has too often been the British way to lend millions sterling which have not brought back to us the consequent contracts to benefit our industries. The Teutonic way has been to get a footing, to elaborately entrench, and to create by this, that, and the other way, under the terms of the concession, or by local arrangements, a system and an atmosphere which made it necessary for German apparatus and supplies to be employed, and so the capital put down, either to buy or to develop the undertaking, has brought both dividends and contracts too. An excellent arrangement no doubt for the other fellow, and one that makes us regret that it is ever possible for a British undertaking abroad to be sold to foreigners at however high a premium on the shares. The loss or thereabouts of a coming market for manufactures over a period of years, may mean far more to us industrially than the mere premium gain that came to the few lucky shareholders. These bargains look very nice on paper when we consider them from an investor's point of view—we like to read of men (other men!) making money out of electrical investments, but we do not like the transfer to what we now call "enemy hands," of undertakings which carry with them valuable trading facilities and connections. The United States then is up against European financial influence in its efforts in certain South American fields, and some of its advisers are not too confident that efforts to establish far-reaching schemes for the development of permanent future trade connections are going to yield all that the apparently favourable factors would suggest as being probable or possible. There is no doubt whatever that very determined efforts are being made there by American manufacturers, under the auspices of the U.S. Government, to take advantage of the present disabilities of European countries. Those efforts have been the outcome of a scheme which is outlined in a recent Commerce Report. One part of the scheme—a feature with which we are by no means unfamiliar—is this:—Arrangements are being made for giving training-course positions in American manufacturing plants to young South American technical graduates. Several firms have expressed their willingness to take these students, and it is now proposed that the scheme shall be extended to the training of South Americans in the offices of commercial houses. The advantages of the scheme are obvious. In some cases the students will return to their own countries as representatives of American houses. They will be well-equipped, native representatives, familiar with conditions in their own countries, and naturally loyal to the firms with which they have studied and worked. Even if later they enter business for themselves, or engage in entirely different lines, it is confidently expected that their influence will continue to make itself felt. Señor Eduardo Carrasco, chief of the commercial section of the Foreign Relations Department of Chile, who is at present visiting the United States to make a study of American commercial methods, is also establishing committees in the more important American cities to help young men, selected by a committee in Chile, to find positions in the universities, factories, or commercial houses.

Investors' Gain—a Traders' Loss.

To Americanise the Student Mind.

As we say above, we are used to this sort of thing. Particularly have British electrical engineers who have followed occupations in such countries as China, had very good reason for knowing how important a card this was in the hands of German electrical manufacturing works. The managers or heads of such works in Berlin or elsewhere in Germany took the long view of things, and the readiness with which they would offer to take the sons of influential Chinese gentlemen into their electrical works in Europe, and give them several years' training, is perfectly familiar to those of our readers who followed the "Correspondence" columns of this journal a few years ago. The young Chinaman duly takes up his place in the German factory, the father is placed under an obligation to the company, and not many months after, a personal letter from some distinguished official or other of the concern is received by the fond parent reporting the "progress" that his excellent son is making, and suggesting in the closing sentences that the time may now have arrived for orders for the requirements for a certain electrical installation, in which the said parent is interested, to be placed with the works where his dutiful and promising son is employed. That is the German method. You have one of the examples of the British way in evidence at the Hong-Kong University, where, by the foresight of Professor C. A. Middleton Smith, by the generosity of a number of British manufacturers, and by the efforts of this Journal, there exists to-day in the engineering laboratories a collection of machinery and apparatus destined to make a lasting impression upon the minds of thousands of young Chinese engineers who, after completing their studies, will go to the different parts of China with the names of British engineering firms "at their finger tips" so to speak. But we have no monopoly of this method of foreign education. Our rivals practise it wherever they get the opportunity.

Father and Son: A Family Obligation.

Can We not do More?

Whether this country has ever done so much as it ought in trying to educate the minds of potential buyers who pass through the engineering and other colleges in the countries which must depend on industrial nations for many years to come, is at least doubtful. Whether we have given sufficient facilities for such students to come into our factories and so familiarise themselves with British manufactures and abilities is also a point we should do well to consider. We hear that one organisation is already trying to arrange such a matter effectively in the lands of one of our chief Allies. We may be pretty certain that Germany will not do less of this kind of

thing again, if she gets the chance, and from what we have said in the foregoing it is clear that the United States is going to adopt the practice as one of the long ways of winning South American trade. In the North, the geographical nearness of Canada has given the States untold advantage. In the South, Canal or no Canal, the problems are very different. There is no United States atmosphere; there are strong competitors on the ground in normal times—competitors whose hold is good, whose roots are deep, and whose knowledge of the markets is not a thing to be scoffed at; so the problems must be tackled in a different way. It seems to be thought, however, that if South Americans can be Americanised as many Canadians have been, practice may be inclined to pursue a favourable course for the United States in time. Part of that Americanising is to be found in receiving South Americans into United States works and colleges.

The Outlook in Canada.

The greatness of the engineering potentialities of Siberia has been frequently referred to in these pages. We have lately conversed with young Colonials who have come Home at the Empire Call after years of daring and interesting prospecting work in certain parts of Western and North-Western Canada, and their stories of what the future has in store for those who make the venture there are as fascinating and entrancing as the fairy tales of our childhood and as wonderful as the tales of the Arabian Nights. But for the time the war-fiend holds the key. The movement is Homeward for our sons—not to the lands across the seas at present unless they have "done their bit" and can do no more. Population has re-traced its steps in order to aid in our endeavours to wipe out the menace of the hydra-headed monster of Central Europe, so that the Colonial Britisher in a free, pure atmosphere, may carry on his occupation knowing that the heritage of Freedom for which our Empire stands is not endangered. Population more than ever will our Colonies require, and after the war they will doubtless gain more than they have lost by the war. The financial position, too, has been a serious factor in Canada for some time, but munitions work and a glorious harvest will ere long assist to relieve the situation—indeed, already the tide of prosperity has risen in the East, and it will doubtless soon reach the West. The Canada of the future will be a different land, and the character of the people will be somewhat changed. The huge munitions contracts are not being executed without leaving their mark upon the manners, habits, occupations, etc., of many of the people, and Canadian peace-time manufacturing operations will probably be more mechanical in future than in the past. May-be some of the lines of manufactured goods that were freely brought up over the border from the States will be Canada-made. For that we must wait and see, but what is happening at present will form one of the new factors to be taken into account in considering the future position. We hazard no opinion at the moment regarding the future of British electrical importations into Canada, for the position is a peculiar one. We have our hands so full, or prospectively so full, with markets nearer home, and possibly on some grounds easier to work, that there will be less reason to begrudge the States the greater opportunity for strengthening their hold on the market that the war has inevitably brought to them. We shall do well, however, not to neglect the market, for after a few years, given population and financial ability, the strides that Canada will take out West will be large indeed; where the railway goes there will be a need for electricity, especially remembering the great hydro-electric traction work that is now in hand or planned, and if we *can* meet the need we shall have at any rate a share of the spoils.

A Period of Change.

The Promise of Siberia.

But we did not start out to write about Canada—we were led on to it by our sentence about Siberia—to which it has been likened by those who have with eager eyes studied the position in their travels through both countries. Canada is a land of promise, of course, but Siberia is a land of promise too, almost beyond the limits of our poor industrial imagination, and the United States trade authorities, who know something about the matter, have, in one of their Commerce Reports, circulated among American firms some information which has been prepared by a special *Canadian* Trade Commissioner on "Trade Development in Siberia." So great is the Russian and Siberian territory, and so vast the population, that when once the wheels of what we may term ordinary industrial life have been set smoothly running, the requirements for machinery and many engineering supplies will be immense.

British Firms Co-operate.

The opportunity has been recognised for years by a number of British engineering firms, though we suspect that so successful have been their efforts in Russia that they have not needed as yet to push their efforts on to those farther eastward points which form part of their original project. We congratulate them upon their success, and we welcome with feelings akin to delight the co-operative efforts which have been set on foot by the seven British electrical manufacturing concerns who have grouped themselves for Russian business in a separate organisation—the Electrical Manufacturers' Company of Great Britain, Ltd.—to which we referred in our issue of December 31st, 1915. We may return to that most timely and promising scheme later, but meanwhile we quote the comments of the Trade Commissioner who has reported upon Siberia. He finds that during recent years a very marked progress has taken place, due largely to the opening out of transportation facilities—what a building of railways there will be in many parts of the world when this war is done! The whole hydrographic system that supplements the Trans-Siberian Railroad is bisected by that railroad, and for thousands of miles, north and south of the line, there is provided a splendid means of cheap access to vast areas during the greater portion of the year. These facilities are being continually increased by the construction of new railways and by river-improvement works, which aim to connect the whole river system of the country for practical transportation purposes. Trade expansion is shown by the business of the fairs and markets, the carrying trade returns of the chief centres of distribution, the growth in the number of banks, forwarding houses, insurance offices, etc., and the extraordinary activity in the building trade. The census figures of 1910 show an increase in the number of factories of 75 per cent., and of 150 per cent. in their output over those of 1900. Flour mills, sawmills, and breweries have been responsible for a considerable portion of the increase, and practically the entire equipment of these and similar undertakings was imported. Moscow merchants control fully 50 per cent. of the trade of Western Siberia. These firms have branches in the principal centres, but the purchases for their stores are made in Moscow. The growth of the country and the establishment of strong local independent firms is, however, tending to produce more direct buying. Most foreign firms have been content to leave their representation in the hands of a single firm in European Russia, and to pay little attention to the Siberian market. Germany has, however, by trade grouping, and the employment of competent travellers speaking the language, been able to build up a direct trade on a satisfactory basis. This trade grouping, with a view to sharing the somewhat high expense, is now

Developing Siberia.

recognised as being of first importance, and local agents urge that responsible representatives of grouped industries should visit the country and get into touch with local conditions. Here, as in Russia. circumstances require the granting of extended credit, but the cost of credit can be realised in the prices. It is practically a question of finance—money out on loan. Shall we ever be able to employ that weapon to a sufficient extent to meet our rivals on their own ground? Electrical supplies have hitherto been almost entirely in the hands of Germany, but, with the depletion of accumulated stocks, and the stoppage of that source of supply, electric light fittings, lamps, bell-pushes and fans, meters, as well as dynamos and other plant, are said to be urgently required. And so we see Siberia holding out her hands of welcome to Allied electrical and engineering manufacturers.

(To be continued.)

BRITISH ENGINEERING TRADE EXPANSION.

By Edgcumbe Brighten.

It is the opinion of many that the time has now arrived when the question of after-war trade should be reviewed.

If Great Britain is to make the most of the advantages it will have obtained at the termination of the war, active steps must be taken to prepare the markets of the Empire and neutral countries for the enormously increased output of material which will be available owing to the extension of factories which are now engaged upon war work.

An important step in a campaign to promote the extension of our trade would be to form an association covering all the engineering and hardware industries. Such an association should seek the co-operation of all existing trade associations, and should be governed by a council consisting of representatives of such. The chairman or president should be a neutral personage, not connected with any other association.

The work that such an organisation should carry out, to be effective, must be very extensive. Its first duties would be to initiate a campaign within the British Isles by means of meetings, articles in the Press, etc., to bring home to the people the value and quality of British goods, pointing out the fact that Germany has been able to wage this war to a large extent through the support we have given her by purchasing goods and financing her industries in the past, and showing that one of the surest guarantees of Peace in the future would be the permanent annexation of enemy trade.

The association should interest itself, and use whatever influence it possessed, in protecting the interests of its members engaged in export trade.

The activities should be of the most wide-spread character. Capable representatives, chosen from local residents (British) who have had experience of some years' standing in such country to which they may be appointed should be sent to the great trade centres abroad.

The policy that has been adopted in the past by other associations of appointing people without experience, or without knowledge of the country, has proved its futility by its lack of usefulness.

Such foreign or colonial representatives would have, beyond the primary object of interesting natives of such country in British goods, the duties of keeping the association advised as to the possibility of future business. Also, it would be such a representative's business to encourage friendly legislation as to tariffs favourable to British goods.

The immense benefit that would be obtained by members of the association if its representatives abroad were organised on such lines as to be able to supply information in relation to business in prospect. would be too high to estimate.

The system that I put forward is that the agent or representative of any members of the association in any country should be kept advised as to possible new business by the resident representative of the association in such country, instead of information being sent to London before being disseminated. To obtain information of value, the representative would have to be an expert organiser.

The cost of maintaining such an organisation would be high, as I do not think a representative suitable for such an appointment in any country could not be found under £800 to £1,000 a year. A cheap man would be of no value to the association. In some cases this estimate would have to be very largely exceeded.

I think that as each industry represented in the association should have its interests properly maintained, a section covering each industry should be arranged.

One of the chief reasons why Germany has been so successful in pushing her engineering products in foreign countries is because she has offered many inducements to young men—sons of possible purchasers or manufacturers of industries—to go to Germany to receive their technical training. The importance and value of doing this is, of course, easily apparent to anyone, for to train a boy just as he is reaching manhood, and is susceptible to influence, is to create a life-long sympathiser. From personal experience, I have found it always most difficult to do business abroad when the prospective buyer had received his instruction in Germany, as he invariably thinks in German and believes in German methods.

One of the great difficulties with which we in this country shall have to contend after the war will be labour. I think it will be absolutely imperative that the situation be explained to the trade unions and to the Labour leaders. Also, one of the troubles that will have to be faced by manufacturers will be the continuance, and possible extension, of the policy "Ca Canny" or—limitation of output. It should not be assumed that the limitation of output is caused entirely by socialistic or labour principles, because one of the chief reasons that brought about the adoption of modern trade union restrictions was the frequent tactless behaviour of certain employers. To be more explicit, the limitation of output has frequently been brought about by fear on the part of the workmen that the "piece rate" would be reduced. At this point I leave the question, finally, believing that careful, cautious, and unbiassed negotiation would do much to reduce the evil here mentioned.

Unless the greatest care is exercised by His Majesty's Government after the war in disbanding the armies then in being, the fear of unemployment will be so great that all possible restrictions which can be put into force by the trade unions will be exercised to their utmost.

To combat such a policy, an extensive campaign should be inaugurated, to extend to trade unions, the Labour leaders, and the workmen themselves, so that there would be no reason for the fear of unemployment if labour would realise that the securing of markets and trades now dominated by the Central Empires should be effected by this country. From my experience and knowledge of many Labour leaders, I am convinced that they and the men could be interested. The spirit of patriotism, and the knowledge of what large wages mean, will make the near future a most opportune time for such a campaign.

I may be accused of laying too much stress on this question of labour, but I believe that unless action is taken, the time immediately succeeding the war

will hold almost as much danger for this country as that with which we are now faced.

The fact that thousands, hundreds of thousands, perhaps millions of men will be released on to the market of labour after the war, is not fully realised. Industries and factories will have to be reorganised, and I fear that, in the meantime, the percentage of unemployment will be very high, with the cost of living not reduced. The situation that may arise is not difficult to imagine.

The expansion and recapture of British trade should be commenced as soon as possible, so that the seeds may be sown and the crops ready for reaping at the cessation of hostilities.

COKE AS A BOILER FUEL.

By E. W. L. Nicol, A.I.E.E.

The article on the above subject which appeared in the Electrical Review for December 31st (page 839) is of considerable current interest in view of the present high cost of coal and shortage of supplies from the usual sources; and, on the other hand, the plentiful supplies of coke available, particularly in districts so affected.

At many of the more important gas works during the present period of maximum demand for gas, the output of coke is to some extent controlled by increasing or decreasing the manufacture of carburetted water gas in its relative proportions to that of coal gas, as carburetted water gas plant is a consumer—not a producer—of coke. The residuals from which the much required, high explosive by-products are derived are, however, obtained only in the process of coal gas manufacture. This fact, coupled with the curtailment of export and shortage of labour, necessitates fresh outlets being obtained in directions which do not entail the employment of extra labour other than grading or loading into trucks or barges.

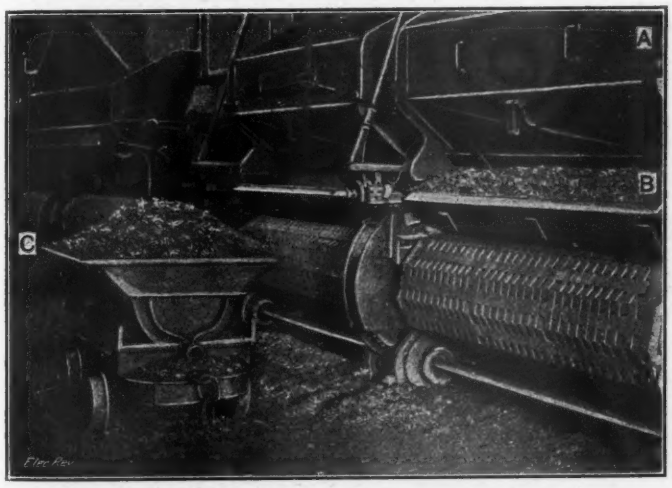


Fig. 1.—Chain-grate Stoker adapted for Burning Coke.
An auxiliary hopper B for coke is fixed below the usual hopper A, and the coke C is fed upon the grate with a thin layer of coal on the top of it to ensure its ignition.

The method of adapting a chain grate to burn coke, as illustrated in the previous article, is simple, and, no doubt, effective, but the air leakage through the improvised grate bars in the feed hopper would result in relatively poor thermal efficiency and low evaporation being obtained. The photograph reproduced herewith shows how chain grates working in this country under boilers of 20,000 lb. per hour capacity, have been modified to burn coke without material reduction in capacity or efficiency. In this case the ignition arch has been retained, and satisfactory ignition is effected by admitting a thin layer of coke slack with the coke, which is graded to convenient size. With this method, air leakage into the furnace is eliminated and normal capacity and efficiency are obtained.

To break and grade coke to suitable size, for either coking or sprinkler-type stokers, should not be a matter of very great difficulty. An ordinary coke cutter, absorbing about four or five H.P., will deal

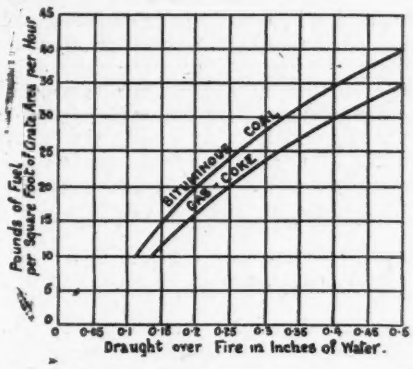


Fig. 2.—Rates of Combustion of Coal and Coke.

effectively with 30 tons per hour at a very insignificant cost.

The results of other evaporative tests, given in the previous article, on ordinary fixed grates showed the higher evaporative value (about 10 per cent.) of coke, as compared with coal of a higher calorific value, obviously due to the smaller proportion of excess air necessary in burning a non-volatile fuel and consequent greater proportion of CO_2 obtainable in the waste gases.

As to the relative cost of coal and coke as boiler fuels, due regard must be had to quantities, locality and delivery facilities. Taking the river Thames, prices for washed slacks having an average of about 12,500 B.TH.U. have lately been about 30s. per ton, including delivery, while coke of equal calorific value, and, as it has been shown, of considerably greater value to the user, may be obtained in the required quantities at considerably less cost. Having these figures in mind, and the fact that the normal surplus of coke exported, according to a recent Home Office report, is about two million tons annually, there should be little hesitation in making, not temporary and improvised, but permanent provision to utilise these sources of supply. The surplus normally available on the Thames is probably from 400,000 to 500,000 tons of coke and coke breeze annually.

From the national point of view, which is one of considerable and growing importance, every ton of coke made from sea-borne coal and used in towns and cities in place of rail-borne steam coal will relieve the congestion on our railways to that extent, while the equivalent, in the case of Welsh coal, which is less suitable for carbonisation, would be released for export.

In considering the question of substituting coke for coal fuel in a power station handicapped by being laid out and equipped to use a uniform class of coal only, the problems of storage and capacity of machine stokers and boilers naturally arise. The reserve stocks of coal usually carried by gas authorities are necessarily considerable and, to a coke-user buying under contract, would, of course, be available.

This consideration should to some extent offset the disadvantage of the relatively greater bulk of coke. At normal rates of combustion, and with equal draught, the steaming capacity of a hand-fired boiler will be reduced by about 15 per cent. to 20 per cent. by substituting coke for coal of similar calorific value (see diagram, fig. 2). There are, of course, ready means of supplementing an inadequate draught, but in the case of stokers of the coking type the problem is more complicated. To start from the beginning, there are obvious bargaining and other advantages to be realised by installing a stoker that will equally well handle coal, coke, coke breeze, and possibly anthracite, and it is a matter for considerable satisfaction that such a stoker has been developed and is now receiving the patronage it deserves in this country. While on this subject it may be profitable to anticipate the trend of the findings of the several committees appointed to deal with the question of fuel conservation and smoke abatement. The national requirements in high-explosive material and other by-products of coal carbonisation will, no doubt, be held to be paramount. The future tendency will therefore probably be to discourage shipment of coking coals, and gradually to limit export to anthracitic non-coking and other coals less suitable for carbonisation. The resulting output of coke will necessitate improved means for its economic combustion under steam boilers, in gas producers and for domestic use.

THE MAGNETIC HAND.

One of the lamentable results of the great war will be the return of many thousands of our brave comrades, martyrs to the cause of liberty and progress, crippled for life by the loss of a hand or arm. Obviously it is of the first importance to adopt every possible means to enable these men to resume their customary occupations, by the provision of efficient substitutes for the missing members. With their usual foresight, our enemies are taking steps to cope with this difficult problem, and in a recent issue of the *E.T.Z.* Prof. Klingenberg, one of the leading electrical engineers of Berlin, describes a number of devices which have been developed for that purpose. We reproduce herewith the illustrations which accompany his article. Fig. 1 shows an armlet which can be strapped on the stump of the arm, and is provided at the end with a pot magnet; the latter is

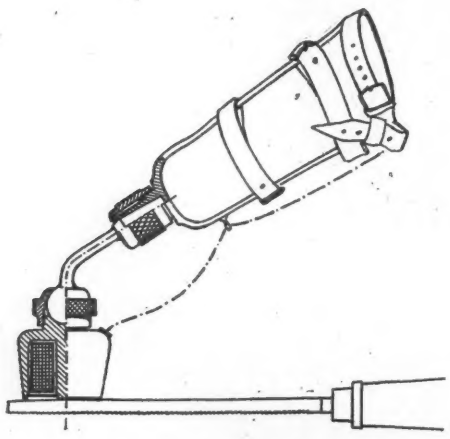


Fig. 1.—Magnetic Hand Holding File.

mounted on a ball and socket joint, so that the magnet poles can be brought into any desired position, and the magnet can then either be clamped firmly or left movable with a moderate degree of friction. The magnet is supplied with current by means of a flexible cord and a plug, the current being switched on and off by the movement of some other part of the body such as the foot, the chin, or the sound arm, or by a particular movement of the injured arm itself. With this device all articles made of iron can be held in a powerful grip for any length of time, and can be lifted and moved about or released, at pleasure. Hence the magnetic hand is suitable for all jobs in which iron tools or iron articles are employed. As a rule, therefore, the tools need not be specially made to suit the requirements of the maimed man. In the example illustrated in fig. 1, the magnetic hand is holding the end of a file, and being movable with regard to the armlet, offers no hindrance to the control of the file with the sound arm.

Fig. 2 shows a plane which is fitted with a small iron plate for the magnet to take hold of, and which is handled exactly like any other plane. Stamping machines working on sheet-iron can be managed as well as with a sound hand, or even better, for the magnetic hand can grip the smooth

Fig. 2.—Plane Fitted with Iron Plate.

surface of the sheet. Work can be put into lathes, &c., with the aid of the device while the sound hand makes the adjustments. Tools which are not made of iron can often be easily fitted with iron plates, and switchgear can be manipulated if the levers are so fitted. Magnets of different sizes and tractive forces can be fitted to the same holder.

The plain magnet, as above described, suffices for a variety of simple operations; improvements in the device will readily suggest themselves in particular cases. By means of a switch to fix and release the magnet alternately, the rotation of iron articles can be effected. Special tools can also be devised, such as those illustrated in figs. 3 and 4, which represent tweezers, pincers, and pliers, actuated by electromagnets. The author further states that there is no special difficulty in providing for the movement of the forearm with respect to the upper arm, the gripping action of artificial fingers, and of the thumb, &c., and he concludes by pointing out the exceptional facilities afforded by electric

Fig. 3.—Magnetic Tweezers.

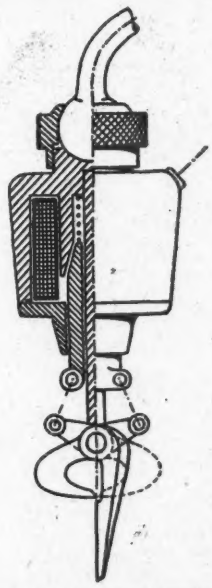


Fig. 4.—Magnetic Pincers or Pliers.

power for fulfilling these various functions, as compared with other agencies. The use even of a portable battery to energise the magnet when away from an electrical installation is not overlooked. No stone should be left unturned to aid our crippled workers, and we trust that good results may be obtained from these interesting suggestions.

THE ELECTRIC PROPULSION OF SHIPS.

IN a paper read before the INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND by Mr. J. DORNAN, the relative efficiencies of different systems of propulsion of ships were discussed. The author stated that turbo-electric systems had been fitted into one ship in this country, four in the United States (including a battleship now building), and one ship in Sweden. Seven steamers were building in Sweden which would be fitted with the Ljungström system of turbo-electric propulsion, aggregating 10,200 H.P. The turbine, however, had not secured a firm hold on the average tonnage of this country, mainly owing to the high turbine speed necessary for economy. He had worked out the data for the equipment of a ship displacing 21,000 tons and running at 19¼ knots, on seven systems as follows:—

(A) Two sets of quadruple-expansion steam engines driving twin-screw propellers direct at 85 R.P.M.; saturated steam at 210 lb. pressure per square inch; vacuum in the condensers of 27 in.

(B) One set of turbines arranged in series on four shafts running at 290 R.P.M.; saturated steam at 200 lb. per square inch; vacuum 28 in.

(C) Similar to (A), only steam is superheated 200 deg. F.

(D) As (B), only steam is superheated 100 deg. F.

(E and F) Geared turbines arranged on two shafts. The former has two turbines running at 1,000 R.P.M., and driving twin-screw propellers at 200 R.P.M. through hydraulic gearing of the Föttinger type. The latter has four turbines arranged in series, driving the propeller shafts through Parsons mechanical gearing at 1,800 and 160 R.P.M. respectively. Superheat, (E) 200 deg. F., and (F) 100 deg. F.; working pressure 200 lb. per square inch, and vacuum 28½ in.

(G) Two shafts driven at 85 R.P.M. through Parsons mechanical gearing by electric motors running at 500 R.P.M., driven from two Ljungström turbo-dynamos which run at 3,000 R.P.M. Vacuum 28½ in., working pressure 200 lb. per square inch, superheat 260 deg. F.

As the rotors revolve in opposite directions, the relative revolutions of the blade disks are 6,000 per minute, and, therefore, only one quarter the number of blade rows are necessary as compared with a single-rotation type turbine of 3,000 R.P.M.

The dynamos and motors are three-phase A.C. for 2,500 volts. The manœuvring is mainly done electrically, speed regulation being obtained by resistances in the motor circuits when manœuvring, and by altering the speed of the turbines when reduced power is required for a lengthened period of time. Reversal is effected by interchanging the poles of the phases.

The figures calculated in the table are based on actual performances of machinery recently built.

By mechanical efficiency is meant the sum of all the mechanical losses between the point where the horse-power developed is measured and the power delivered to the propeller.

The table shows the steam and coal consumptions of the various designs, also weights of machinery and particulars of extra deadweight and cubic capacity.

By primary horse power in line 3 is meant the power which must be put into the prime mover to provide the necessary horse power in line 2. The losses in the mechanical gears of design F have been taken at 2 per cent., and the primary horse power of the turbines is, therefore, 21,800. In addition to the mechanical gear losses as in F, design G has losses due to the dynamos, cables, and motors. These amount to 11½ per cent., including a 2 per cent. loss in the helical gears.

As the turbines used in E and G always rotate in the one direction, no matter whether the propeller is going ahead or astern, and thus eliminate the troubles due to astern turbines, high superheats are used. Design G, having Ljungström turbines, can safely use as high a superheat as 350 deg. F.

The distance run by the ship in nautical miles per ton of fuel burnt is shown in line 12. These figures are very important, and from them the economies in line 13 have been calculated. This is the most just and accurate method of computing economy, for such variables as horse powers, revolutions, and steam consumption per primary horse power are eliminated.

It is difficult to calculate the years for depreciation for each type of prime mover, but it may be safely stated that design G will be an efficient and modern one many years after A is obsolete, as the probability of a new invention increasing the efficiency of G is very much more remote than of one improving A. An attempt to state the years of life is shown in line 23. These figures are extremely important, as the rate of depreciation being decreased from 6¾ per cent. of A to 4½ per cent. of G means some £3,000 per annum.

Line 25 shows the net annual return on the cost of ship. These figures are the most important in the table. They have been calculated after allowing for the usual deductions from the gross returns, and for the years of depreciation stated in line 23.

It is hoped that the comparisons made will clearly show that by spending 4½ per cent. more money in the first instance, the net annual return may be increased from 7 per cent. in A to 15 per cent. in G.

The selection of a 21,000-H.P. 19¼-knot design forms a good point to view the application of the various alternatives to ships having higher or lower powers and revolutions corresponding to the power and speed.

If the lower scale be first considered, machinery types B, D, and E become more and more inadmissible, as the horse-power and revolutions decrease, on the grounds of extravagance in steam consumption, of excessive weight, and abnormal dimensions. Types A and C are applicable to the lowest of powers and revolutions. The steam consumptions of these types, considered alone, favourably compare with some of the other designs, and it is the excessive weight that places the piston-type machinery at a disadvantage.

Types F and G are applicable to the lowest powers, with the stated degree of economy maintained and very often improved.

Taking now powers and corresponding revolutions, higher than in the case examined, types A and C fall out of the running very quickly, as the weight of machinery and necessary space become too great.

The remaining designs are all applicable to high powers with even better results than given in the table. Type F would, however, require to have four shafts with eight or more turbines for higher powers, on account of the dimen-

Reference letter	A	B	C	D	E	F	G
Design.	Quadruple engines.	Direct turbines.	Quadruple engines.	Direct turbines.	Hydraulic gears.	Mechanical gears.	Turbo-electric gears.
1. No. of shafts	2	4	2	4	2	2	2
2. I.H.P. or S.H.P.	21,650	21,800	21,650	21,800	21,300	21,350	20,000
3. Primary H.P.	21,650	21,800	21,650	21,800	23,450	21,800	22,600
4. R.P.M.—Propellers	85	290	85	290	200	160	85
5. ,, Turbines	—	290	—	290	1,000	1,800	3,000
6. Superheat, Fah.	Nil	Nil	200°	100°	200°	106°	260°
7. Vacuum, inches	27	28	27	28	28½	28½	28½
8. Steam per hour, total pounds	318,000	302,000	261,000	276,000	246,050	255,200	196,240
9. Equivalent coal per hour, lb.	31,800	30,200	27,200	28,200	25,700	26,000	20,650
10. Coal used per H.P.-hour, lb.	1·47	1·385	1·257	1·292	1·205	1·218	1·032
11. B.TH.U. per H.P.-hour	20,600	19,400	17,600	18,100	16,900	17,050	14,500
12. Distance run in nautical miles per ton of coal	1·355	1·426	1·585	1·53	1·68	1·67	2·09
13. Economy over A, per cent.	—	5	14½	11½	19	18	35
14. Coal per day, tons	341	324	292	302	276	279	222
15. Weight of machinery plus bunker coal, tons	6,403	5,557	5,946	5,316	4,653	4,837	4,086
16. Gain in deadweight, tons	—	846	457	1,087	1,750	1,566	2,317
17. Cubic capacity gained, feet	—	18,100	21,200	24,250	64,900	56,970	80,600
18. Value of coal saved	—	£2,550	£7,350	£5,850	£9,750	£9,300	£17,850
19. Value of extra deadweight carried	—	14,213	7,678	18,261	29,400	26,308	38,925
20. Total saving per annum	—	£16,763	£15,028	£24,111	£39,150	£35,608	£56,775
21. Cost of ship	£650,000	£650,000	£668,500	£670,500	£673,000	£672,000	£678,000
22. Brake efficiency	0·70	0·68	0·74	0·70	0·76	0·71	0·87
23. Probable years to render machinery obsolete	15	16	17½	17	18½	18	22
24. No. of boiler furnaces	64	64	60	60	56	56	44
25. Net annual return on cost, per cent.	7	9½	9	10	12½	11¾	15

Assumptions made:—Ship at sea 150 days per annum—*i.e.*, 24 voyages. Average cost of coal = 20s. a ton.
One ton deadweight worth 14s.

sions of the gearing, and is, therefore, at a disadvantage over E or G.

With a view to securing further economy in turbine-driven ships, it is recommended to increase the propeller revolutions, so as to produce machinery which will be small and light, and also decrease the steam consumption, so that a larger number of nautical miles may be run per ton of fuel than in ships having slower-running propellers. The machinery would also decrease in first cost, not per unit of weight, which would, of course, increase, but per unit of power, which is the more important factor. The decrease in fuel used, and the decreased capital cost of the ship in conjunction with the increase in cargo capacity, will result in a commercial success satisfactory to all concerned.

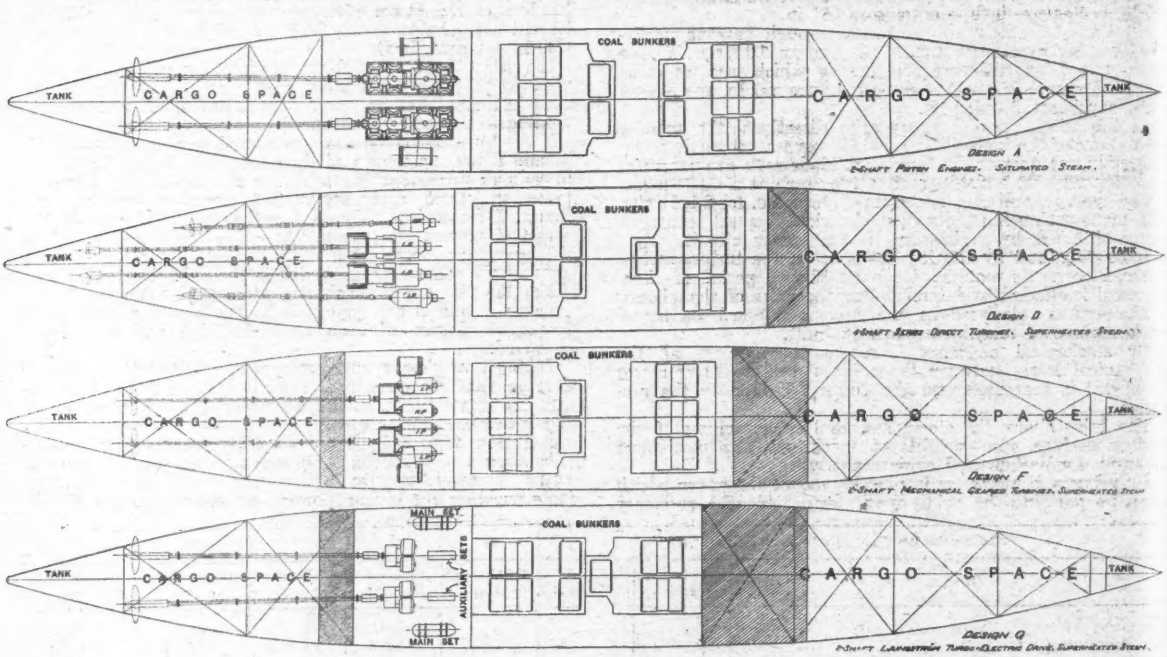
DISCUSSION.

Mr. P. A. HILLHOUSE said that the centre of gravity of vessel G with Ljungström turbines would be about 3¼ ft. higher than design A with reciprocating engines, which would probably necessitate an increase in breadth, or a reduction in the displacement, even if the Ljungström turbine had the same height of centre of gravity as the reciprocating machinery. Mr. Dornan showed the increases of deadweight, as compared with the ship having reciprocating machinery, and he also showed the increases of cubic capacity. In the Ljungström turbine ship it would not be possible to utilise all the increase in deadweight, owing to want of stowage space, and probably some compromise would have to be adopted.

Mr. W. D. MCLAREN compared the turbo-electric gear G with the mechanical gear F, and pointed out that, in the former, the revolutions were chosen at 85 per minute, and in the latter 160 per minute. The net result of this change was that he got improved propeller efficiency, and so saved 1,350 H.P. The steam consumption per H.P.-hour of the main engines was only 7.4 lb.; from the data supplied, this necessitated a turbine efficiency based on the Rankine cycle of 83 per cent. He was aware that the Ljungström turbine showed a higher efficiency than any other which had yet been constructed, but he would be somewhat chary in placing it at this figure for continuous service conditions. Using the same propellers in F and G, and assessing the turbines of G at about 10 per cent. higher efficiency than in F, the overall efficiency of G would not be greater than the overall efficiency of F. If such were the case, all the other considerations would be levelled down. He was aware of the difficulties of admitting superheated steam to an astern turbine which might have been working at a comparatively low temperature, but there were ways of overcoming these difficulties, such as adopting astern turbines of the impulse type. It would be noted that the greater proportion of the saving effected by each type of machinery, as compared with design A, was due to the extra deadweight that Mr. Dornan estimated could be carried; even though the difficulties mentioned by Mr. Hillhouse were in some manner overcome, it did not follow that the cargo accommodation would be fully utilised every voyage.

Mr. H. S. PORTHAM said that design A, he understood, represented actual figures, and design B represented the trial figures of one of the most recent turbo direct-driven Atlantic liners. The performances of the other designs appeared to him to be based on sound and well-established data. The electrical system, design G, yielded the maximum ratio between speed of prime mover and propeller shaft. The Ljungström turbine, owing to its highly ingenious construction, was designed for a maximum obtainable superheat, and the resultant economy stated in Mr. Dornan's paper was by no means a speculative one. The Swedish boat *Mjölner*, of 850 S.H.P., with Ljungström electric-turbo drive, had been running since December, 1914, between Stockholm and Gothenburg, and her performance compared well with her sister ship, *Mimer*, running on the same route, and fitted with triple-expansion reciprocating engines. With similar coal of 13,500 B.TH.U., the electrical ship's daily consumption in 24 hours was 9 tons when developing the equivalent to 940 I.H.P., as compared with the consumption of the *Mimer* of 15 tons under the same conditions of power, speed, weather, and displacement, showing a saving of 40 per cent. The coal consumption reduced to I.H.P. in each case was .89 lb. for all purposes in the electrically-driven ship, and 1.52 lb. in the ship with reciprocating engines. The steam conditions in the *Mjölner* were:—Pressure 200 lb., superheat 190 deg. F., and vacuum 29 in.; in the *Mimer*, saturated steam, pressure 180 lb., and vacuum 26 in. (barometer 30 in.). An aggregate of 10,000 H.P. was now in course of construction in Sweden for five additional electrically-propelled vessels, based on the performance of the *Mjölner*, and approximately 200,000 H.P. in Ljungström turbines was either running or in course of completion for land work. It might be interesting to state the results of a 5,000-KW. Ljungström turbo-alternator, which would shortly be running in one of the London power stations. At 40 per cent. of normal full load, the consumption was 8.1 lb. per B.H.P. per hour; at full load the consumption was 7.34 lb. per B.H.P. per hour, in each case for turbine only. The turbine ran at 3,000 revolutions per minute, corresponding to a relative rotation of 6,000 revolutions per minute. The thermal efficiency of the turbine at normal full load, including condenser, worked out at the excellent figure of 79 per cent. The efficiency of the alternator at full load was over 96 per cent., which included exciting and ventilating losses. These results were in close agreement with Mr. Dornan's predetermined figures. Given such a cheap source of electric power as the above, in addition to the ordinary condensing auxiliaries, considerable advantage would be gained by running refrigerating and ventilating plants, sanitary pumps, steering engine, and electric lighting, electrically from the main generating sets, through an intermediate motor-generator. He felt confident that a saving would be effected in the galley and electric ovens. One of the 600-KW. exciting auxiliary sets would drive the auxiliaries and electrical winches in port, and would be a stand-by at sea. Should one of the main generating sets break down, the ship could proceed to port at about 15 knots on one set alone, with unimpaired efficiency, and with equal power on both propellers.

Mr. R. T. C. BLACK pointed out that when a rapid reversal was made a very large amount of energy was transmitted to the shafting, and if any perceptible braking effect was to take place, it must be in the turbine casing. Some indication of the probable limit in the size of the Ljungström turbine for a speed of 3,000 R.P.M. would be of great interest; the largest turbine of the type of which details were available had an output of 5,000 KW. at 3,000 R.P.M. It was understood that this output approached the limit for this speed. Referring to the electrical equipment of vessel G, the motors



SHIP PLANS SHOWING THE INCREASED CARGO SPACE (SHADED) AVAILABLE.

appeared to have 12 poles, which seemed to be as large a number as was consistent with a reasonable power factor. Quite a number of inventors had proposed schemes having ratios of reduction between the generator and motor of the order of 20 or 30, necessitating 40 to 60 poles on the motor. No figures of probable power factors had ever been given, though, from the weights stated, very hopeful views were taken. He took it that the designers of the Ljungström arrangement found that geared motors, including the gearing, were lighter and more satisfactory than large slow-speed motors. Mr. Dornan stated that speed regulation while manœuvring was effected by resistances in the motor circuits. These resistances, capable of handling 22,000 H.P. at 2,500 volts, must be of rather formidable dimensions. There did not seem to be any reason why this speed regulation should not be effected by varying the alternator voltage. The power of an induction motor varied as the square of the applied voltage, which should agree fairly well with the power-speed curve of the ship.

HIGH STEAM PRESSURES.

IN a paper presented at a recent meeting of the American Society of Mechanical Engineers (and reprinted in our contemporary *Power*), Mr. ROBERT CRAMER discussed the possibilities of using higher steam pressures in power plants, showing by means of tables and curves the relative gain in thermal efficiency by so doing; the following is an abstract of his remarks:—

In steam engineering practice the tendency to increase the range of the working fluid has led to the recognition of well defined limits: A maximum steam temperature of about 600 deg. F., above which lubrication of piston engines and maintenance of valves and packings are difficult, and a minimum condenser temperature of about 80 deg. F. corresponding to 29 in. of vacuum, or ½ lb. back pressure. This temperature is so near the usual cooling water temperature that a higher vacuum would require disproportionately large quantities of circulating water. The necessary size of the circulating pump and increase in size of the air pump render higher degrees of vacuum unprofitable.

If, taking these limits, all heat were transferred to the steam at 600 deg. F., or 600 + 460 = 1,060 deg. abs., and all heat were rejected at 80 deg. F., or 80 + 460 = 540 deg. abs., the Carnot cycle would be realised and the efficiency of the engine would be (1,060 − 540)/1,060 = 0.491. Thus nearly one-half of the heat transferred to the steam would be transformed into mechanical energy.

While the condition of the rejection of all heat at the lower temperature can be closely attained, it is impossible to cause the steam to absorb all heat at the higher temperature.

In the best present practice, except for slightly higher pressures in some few isolated cases, the maximum steam pressure is 200 lb. per sq. in. absolute, and the superheat is 200 deg. F. The corresponding temperature of evaporation is 382 deg. F. and the bulk of the heat is absorbed at a temperature of 200 deg. F. below the maximum. It seems reasonable to expect that the approximation to the ideal Carnot cycle, and simultaneously the economy, would be improved by using higher pressure and less superheat; that is, by increasing the temperature at which the bulk of the heat is absorbed without increasing the maximum temperature.

Even a casual reference to steam tables and diagrams confirms this expectation and reveals the remarkable fact that the higher the steam pressure the less the total heat in the steam if the final temperature be kept constant, and correspondingly the superheat is reduced with advancing pressures. This difference, while not great, is decidedly noticeable, as Table I. shows (the values throughout are taken from the Marks and Davis steam tables).

TABLE I.—TOTAL HEAT OF STEAM AT VARIOUS PRESSURES.

	Temperature of steam, 600° F.						
Steam pressure, lb. per sq in.	100	200	300	400	500	600	1,574
Temperature of evaporation, deg. F. ...	328	382	417	445	467	487	600
Superheat, deg. F. ...	272	218	183	155	133	113	0
Total heat, B.TH.U. per lb.	1323·3	1317·6	1310·7	1305·6	1301·8	1298·8	1176·0

An examination of the Mollier total-heat entropy diagram shows that the amount of heat convertible into mechanical energy in adiabatic expansion to any given back-pressure is considerably higher for high pressure and little superheat than for low pressure and much superheat, if the maximum temperature of the steam is the same in both cases.

We have thus two cases making for better thermal efficiency with increasing steam pressure at constant maximum temperature—the decreasing total heat of the steam and the increasing amount of that part of the heat convertible to mechanical energy in adiabatic expansion.

A number of tables, compiled by the author, are included to show what gains can be expected with increased pressures and varying conditions; of these, Tables II and III are a summary showing the theoretical percentage of gain for certain comparisons selected on account of their relation to conditions prevailing in present practice; in the case of atmospheric exhaust these gains are so large as to justify an endeavour to use high steam pressures.

TABLE II.—RELATIVE GAIN IN THERMAL EFFICIENCY DUE TO INCREASING STEAM PRESSURE TO 600 LB. PER SQ. IN. ABS.

Final condition of steam	29-in. vacuum.		Atmospheric exhaust.	
Initial condition of steam	Constant temperature, 600° F.	Constant superheat, 100° F.	Constant temperature, 600° F.	Constant superheat, 100° F.
As against 100 lb. initial pressure...	25 %	30 %	52 %	85 %
As against 200 lb. initial pressure...	13 %	15½ %	32 %	37½ %

TABLE III.—RELATIVE GAIN IN THERMAL EFFICIENCY DUE TO INCREASING STEAM PRESSURE TO 1,574 LB. ABS.

Final condition of steam	29-in. vacuum.	Atmospheric exhaust.
As against 100 lb. initial pressure, 100° superheat	44½ %	187 %
As against 200 lb. initial pressure, 218° superheat	22½ %	105 %

The ideal Rankine cycle cannot be realised in practice. In steam turbines, steam expansion cannot be effected without friction losses, which are converted into heat, and to that extent make the expansion deviate from the adiabatic. It is also impossible to extract fully the mechanical energy manifested in steam velocity, the residual velocity representing a loss.

In piston engines of the double-flow type there are large losses due to initial condensation and heat transfer; in the uniflow piston engine such losses can be almost avoided by suitable design, but it is impossible to carry the expansion down to condenser pressure, because the compression, commencing at the point of the stroke where expansion ends, would be a reversal of the expansion, and no work would be done in the cylinder.

These sources of loss—friction in the turbine, condensation in the double-flow piston engine, and incomplete expansion in the uniflow engine—determine the practical limits of possibility of realising the Rankine cycle. In large steam turbines, the Rankine cycle efficiency has been carried to about 76 per cent., and a very similar efficiency has been realised in uniflow engines, even in small sizes. In the steam turbine, higher steam pressures will mean either higher velocities or more stages, both introducing higher friction losses, although it is to be expected that by careful design the percentage of these friction losses as compared with the total amount of energy available in adiabatic expansion can be kept the same as in present practice.

Present Boiler Design and High Pressure.—The foregoing seems to justify the employment of higher steam pressures. Standard boiler designs, however, do not permit the production of steam at a pressure higher than about 200 lb. without sacrificing safety and without calling for an investment in the boiler plant high enough to offset the gain in economy caused by higher steam pressures.

The solution of the problem of boiler safety under high steam pressures demands two fundamental changes in boiler design.

The boiler must be constructed entirely of tubes of relatively small diameter. All drums and vessels of large diameter, as well as all flat surfaces (even if stayed), must be abandoned.

Expanded beaded or riveted joints exposed to the action of the fire must be avoided. That part of the boiler which receives the heat of the furnace must be practically a one-piece structure.

It is important that in meeting these requirements the essential characteristic of water circulation in the boiler be retained to make possible a control of the steam pressure and of the water content of the boiler by simple means. Flash boilers, while permitting high steam pressures, are not desirable, because they require complicated automatic regulating devices, necessary on account of the interdependence of feed and fire control.

In considering boilers for high steam pressures, it must not be overlooked that the water in the boiler is at a higher temperature than that in a low-pressure boiler. This difference amounts to approximately 100 deg. for 600 lb. pressure, as compared with 200 lb. Even if the heating surface is made large, or, in other words, the evaporation per square foot is kept low, the stack gases will leave the high-pressure boiler at a temperature 100 deg. higher than the corresponding gases of the low-pressure boiler. The boiler efficiency, other things being equal, is correspondingly reduced.

It is possible to meet this difficulty by making the heating surface of high-pressure boilers larger in proportion to what is practised in boilers working under pressures used to-day. It is also possible to increase the effectiveness of the heating

surface by proper design. Boiler designers are realising the possibilities in this direction, even with steam pressures not higher than 200 lb. This is demonstrated by modern boilers which show an evaporation per square foot of heating surface twice as high as was customary only a few years ago, at the same time realising a better efficiency than formerly.

The possibilities of extraneous heat-saving devices should not be overlooked. Even though the waste gases leaving the boiler have a temperature of 700 deg. or more, a properly installed economiser will reduce this temperature to any desired degree within the limits given by the temperature of the feed water.

The question of strength of constructional parts outside of the boiler to withstand high steam pressures is of importance. In reciprocating engines this question can be answered from practice, because pressures far exceeding 600 lb. per sq. in. are used successfully in gas engines and Diesel engines, and therefore the design of cylinders for high steam pressures should not present difficulties not already overcome.

Extra-heavy High-pressure Casings for Turbines.—In steam turbines, especially in those of larger size, the casings of large diameter would need to have disproportionately heavy walls were they required to withstand pressures much higher than those now employed. The solution of the problem of adapting turbines to high pressures is found in the principle underlying most present designs of large steam-turbine units. According to this principle, the pressure of the steam is greatly reduced in the first nozzle and the resulting high velocity is utilised in several rows of blades of the velocity-stage type. Thus it is possible to confine high pressures to the steam piping and to the "steam belt" carrying the steam to the first nozzles, but to have comparatively low pressure even in the first part of the casing. The lesser efficiency of the velocity staging is not so serious at the high-pressure end as it would be at the low-pressure end, because the loss manifests itself in a somewhat higher superheat of the steam entering the succeeding stages and is partly recovered.

With high pressures the difficulties with piping and fittings are reduced on account of the lower specific volume of the steam. Even if lower rates of flow than those at present customary are permitted in high-pressure steam lines (on account of the greater density of the steam), the fact that 1 lb. of steam at 600 lb. pressure occupies approximately one-third of the space required by 1 lb. at 200 lb., reduces the required size of the piping and fittings to such an extent that difficulties in both design and cost for a given capacity are, if anything, less than for lower pressures.

Single-acting Steam Engine.—In piston engines the question of cylinder lubrication is important. It is apparent that high steam pressures will permit neither slide nor Corliss valves. The advent of higher pressure will cause the poppet valve to come into its own.

Most of the lubricating oil now used in piston engines is required for the steam-distributing valves.

For a given output the cost of a uniflow engine suitable for high steam pressures should be less than that of double-flow engines, as soon as it can be manufactured under economical conditions of manufacture. Such an engine, if single-acting, has but one simple organ of steam distribution, and on account of its high mean effective pressure its weight per horse-power is low. Even in a single-acting engine of this type the mechanism is utilised twice as efficiently as in a 4-stroke cycle Diesel engine.

Steam turbines for high steam pressures would probably cost a little more than those using lower pressures and giving the same power, on account of the extra stages required. The extra cost would be offset by a considerable saving in the required condenser cooling surface on account of the larger percentage of moisture in the steam entering the condenser and the reduced steam consumption due to better thermal efficiency. Table IV will make this clear.

TABLE IV.—Reduced Steam Consumption due to Better Thermal Efficiency.

Initial condition of steam.	200 lb. 600° F.	600 lb. 600° F.
Ideal efficiency with 29-in. vacuum	0·329	0·373
Percentage of steam in exhaust	0·814	0·749

Ratio of condenser cooling surface = 0·329 × 0·749/0·373 × 0·814 = 0·812. Thus, a saving of about 19 per cent. of the condenser cooling surface might be expected.

The question of stuffing-boxes can be eliminated in both turbines and piston engines—in turbines because high steam pressures need not be carried beyond the first nozzle, and in piston engines because the single-acting type of engine is from many points of view the logical design for high pressures. In such a piston engine the stem of the one valve can be provided with a "labyrinth" packing.

Auxiliaries.—In very large plants all auxiliaries are often driven by electric power, and the current is furnished by a separate unit. As these "house-service units" in modern power plants have capacities of 2,000 kw. and over, it is simple to operate them directly with high-pressure steam.

Where it is desired that the auxiliaries be driven independently, it should be possible to drive them with high-pressure steam turbines if the size of the auxiliary unit warrants this, or by high-pressure uniflow engines for the smaller sizes. In the latter case the lubrication could possibly be accomplished with graphite only, so that the amount of lubricant introduced into the condenser would be insignificant and harmless.

Another way would be the noncondensing operation of the uniflow engines, using the heat of their exhaust in a feed-water heater. This manner of operation appears to be attractive, because the economy of noncondensing uniflow engines, as compared with noncondensing engines of other types, is high.

It seems clear that if steam pressures are increased to, say, 600 lb. per sq. in. without using temperatures higher than those employed in modern practice, the difficulties encountered by the designer are not formidable and are more easily met than in the case of some types of explosion engines which have been successfully designed. The result to be attained by adopting such high steam pressures appears to be fully worth the effort, because thermal efficiencies closely approaching those of explosion engines can be realised with simpler and less expensive apparatus and consequently better overall economy, at the same time retaining all the practical advantages which steam utilisation has over any other method of producing power.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Limitation of Output.

From all the discussions upon the new trade campaign, which is being so insistently urged at this time, one feature emerges each and every time. So much stress has been laid upon the necessity of the trade unions abolishing the supposed limitation of output, that one is constrained to look at this point in detail, so as to establish the fact beyond cavil, or to show that it may be merely a glib statement which is being produced as a dummy on the stage of argument. It is surely insufficient to lay to the charge of the trade unions that they are deliberately guilty of keeping down the output of their members in the workshops, or that they have done so in the past. After all, there are trade unions in enemy countries, and if there is limitation of output here, one may inquire whether enemy trade unions are faultless. Perhaps the docile Hun would blush to turn out anything less than his full working capacity. Maybe he has more encouragement to do his full share than his British counterpart. Few will dispute that much suspicion and mutual distrust exists between masters and men in this country. One of the causes of this is the feeling that employers never lose an opportunity of lowering prices. The usual piecework or bonus system of payment is too often unfair to one party or the other. Again, there may be in the same shop piecework on one job, and day work on another. For instance, in a locomotive boiler shop the boilers are made on piecework, but it is not possible to fix piece rates for the men who test the finished boilers, because of the great variation in results. One boiler will only take hours to test, where another occupies days. One set of men are drawing bonus regularly, while others maintain only the bare weekly rate. In other cases a piece-rate is easily fixed, but is often whittled away by the employer until only the best worker makes any extra money, and he not much. On ordinary day work the best man draws the same reward as the inferior or more careless worker. It is common knowledge in factories where only semi-skilled workers are employed that the piecework rates are such as to afford the man or woman only a bare existence. Especially so is this the case where girls and women are concerned. The worker has no voice in the matter, except to take it or leave it, and the rates are usually left to the mercies of the time-office or some zealous reformer with an eye on the wage packets.

In the high-speed tool trade the writer has seen night men do their "whack," which is the equivalent of the slowest day worker, and still have plenty of time to spare. The rate paid was the usual trade rate per hour, and the quantity of work was the same for the same money. The trade unions are blamed for such a possibility, but no mention is made of the precise course to be adopted for alterations. The trade rate paid in a district is supposed to be the minimum: in how many cases is it also the maximum, and why should it be so? Output will never be increased while the poor or slow worker's minimum is also the good worker's maximum. The employer is asking for more work in the same time. The worker demands more money. Already since the war began certain semi-skilled and unskilled workers, many thousands in number, have been granted a minimum wage for all over 19 years, plus a war bonus. New demands are now in arbitration varying from 4s. to 6s. per week for the same people. Whether the wages already in vogue are adequate or not is not a matter for present discussion. The facts are simply mentioned to show the present trend. Both employer and worker are out to make the best of the present situation; the one to demand more work as an aid to beat the German, the other to boost up his standard wage for the uncertain future. One can only hope that each may be satisfied. In passing, however, it may be pointed out that the prices of our rivals' goods, if and when they do once more appear in the markets of the world,

will have some influence upon the wages of the British worker, and this should not be forgotten. It would seem better to give a fair wage and see that it is earned, than either to treat all alike on a dead level, or swindle the worker by offering an illusory, and ever-changing, bonus system, under which only the pick of the workers can make extra money.

Restriction of output may be the child of bad times. It is feasible that a man may pardonably not rush his work when he hardly knows whence the next job will come. This has often of old been the case in British factories. No system of protection can guarantee a full order book, but, at the same time, we have too often seen German and other foreign goods on our markets when our own workers have been idle. Restriction of output may, then, even be good; the output of enemy works which flows into our Empire's markets and our home ports. British mechanics will make more money constructing a complete machine than in assembling one made in America. The C.M.A. will have more dividends if they make both the tubing and the cable, instead of making the conduit at home alone, and allowing German cable to be drawn into it. The Minister of Munitions, likewise, will not long complain of his own countrymen "going slow" when once he and his brethren take the plunge and restrict once for all the output of the Central Empires.

Commercial.

Electrolytic Copper.

All engineers will be indebted to Mr. Thos. Bolton, who is an authority on this subject, for his contribution in your issue of December 24th towards finding a generally acceptable definition of hard-drawn copper of circular section, and I feel sure that his views will be fully considered before the Engineering Standards Committee completes its revision of the present standard, which was issued in March, 1910. I fully share his hope that the Director of the National Physical Laboratory will be able to carry out the suggested investigations before any final decision is taken by the E.S.C.

Mr. Bolton is a manufacturer, and approaches the consideration of this subject from a somewhat different point of view to myself. My Manchester address was prepared chiefly from the point of view of the user of hard-drawn copper wire, who has been looking in vain for many years for guidance from the E.S.C., the I.E.E., or the manufacturers, towards a satisfactory definition. Failing this, a considerable advance towards a complete definition has been suggested by Mr. D. R. Pye, and my experience is that an increasing number of engineers are using his formulæ to ascertain what are the MINIMUM values of tensile strength and extension for any particular size of wire. Each formula provides a sort of datum line in each test, and the 4 per cent given in the E.S.C. report provides a maximum extension limit while omitting all guidance about tensile strength.

One cannot help feeling that Mr. Bolton does not fully realise the convenience to the purchaser of hard-drawn wire, who is not an expert, of being able to obtain these MINIMUM values from Pye's formulæ, and of thus having a check on the manufacturers, not only for all standard sizes of wires, but also for the many intermediate sizes which are constantly being used, and of being reasonably sure that, if these figures are attained, he will obtain wire which is free from brittleness.

I have referred to Mr. F. Johnson's contribution to the discussion on Mr. Pye's paper, and I am interested to find that, while he agrees with the view that the strength of wire does not lie in its skin, he also agrees with the practicability of Mr. Pye's formulæ.

With regard to the proposed inclusion of the limit of proportionality in the definition, it is my opinion that this point on the load-extension curve is of more importance than the elastic limit, and for a fuller discussion of this matter, which is not an academic one, I would refer those who are interested to the leading article in the *Engineer* of October 8th, 1915. It is the limit of proportionality which is really of importance to the users of hard-drawn copper wire, as it is the point where the elastic extension ceases to be directly proportional to the load, and where no question of permanent set is involved. My basis figures for the values quoted were taken from the E.S.C. Report No. 55 for wires up to 0.194 in. diameter, and I was surprised to find how low some of them are. They are lower than the elastic limit values which are given by some makers, and which are, in my opinion, misleading, although not intentionally so. The position is unsatisfactory, and I think Mr. Bolton will agree that the uncertainties should be cleared up. The E.S.C. values were based on tests made with great care by the N.P.L., and we must accept these results unless we can show an error in the method or later improvements in the material, or in its method of manufacture. Further tests of the same authoritative kind by the N.P.L. are now needed on wires from No. 5 S.W.G. to 7/0 S.W.G., which have not been specially manufactured for the purpose of the tests.

Under ordinary works conditions, autographic records can be taken, when required, while samples are being tested for tensile strength, and from these the limit of proportionality can be determined with sufficient accuracy for most purposes.

We get on to controversial ground when we discuss wrap and torsion tests in preference to extension tests as a test of brittleness. There is a considerable weight of opinion against the former. The report of the Wire Committee of the American Society of Testing Materials may be quoted against them, and also the fact that American engineers have discarded them, and now use extension tests. With proper apparatus, an approximately accurate extension test need not be a lengthy one, and, further, it is not essential that every coil of wire should be tested nowadays, whatever may have been needed at the time the G.P.O. engineers first adopted their wrap and twist tests.

In conclusion, in adding my own thanks to Mr. Bolton, I would hazard the opinion that he has in mind already a definition of hard-drawn copper which would completely satisfy him. Perhaps, at this stage, it would not be desirable to discuss it in the technical Press, but if the I.E.E. would take the whole matter in hand, as I have suggested, there need be no great difficulty in getting a small committee, representing the I.E.E., the N.P.L., the manufacturers, and the users, to agree on a definition and then to send a joint recommendation to the E.S.C. A little extension of the work would also produce a standard specification.

B. Welbourn.

Rainhill, Lancs., *January 4th*, 1916.

WAR ITEMS.

After the War Trade.—In the House of Commons on Monday there was another discussion on after the war questions, and we think that it must be unhesitatingly described as the best of the three Parliamentary debates that have so far taken place on such matters. The discussion was opened by Mr. Hewins, who moved that, with a view to increasing the power of the Allies in the prosecution of the war, His Majesty's Government should enter into immediate consultation with the Governments of the Dominions, in order with their aid to bring the whole economic strength of the Empire into co-operation with our Allies in a policy directed against the enemy. Other speakers in the debate were Mr. Peto, Sir A. Mond, Mr. Shirley Benn, Mr. Prothero, Mr. Chaplin, Mr. Mackinder, Sir G. Croydon Marks, Mr. Bryce, and, finally, Mr. Runciman. In the course of the speeches reference was made to the commercial position after the war, the economic resources of the British Empire, German organisation and system, the possibility of the rapid restoration of German scientific competition, the prospect of the United States becoming a dangerous competitor, and very many other points that have been covered in articles that have appeared in our own and other journals during the last eighteen months. Mr. Runciman's reply showed that he regarded the discussion as an important one. Had he regarded it as a merely academic one he would have asked leave of the House to be attending to practical business elsewhere. Any decision which the House or Government came to with regard to trade matters at the present time had a direct bearing either on the strength of this country or on the strength of the enemy. He believed that Germany was at last beginning to feel the effects of the blockade. So far as treaties with Austria and Germany were concerned they were non-existent, having come to an end with the outbreak of war. History could not go on, after the war, from exactly the same point. In regard to tariff arrangements between Germany and Russia, the latter would be more likely than in the past to listen in the most friendly spirit to the representations that we might make in regard to future arrangements. How far she would be prepared to go no-one could say. No Russian statesman could yet say exactly the lines on which her economic development was likely to proceed. He was confident, however, that she was not going to make herself the tool of Germany. "Peaceful penetration" would not be allowed to continue in Russia. We should be able to make up our vast losses in a shorter period of time than any other State, and it would be our duty, so far as we could, to aid Italy, France, and Russia in the same process. Mr. Runciman proceeded to justify the efforts made to capture German trade. Many of our firms had built up, during the war, strong connections in South America which he hoped would last long after the war. They had studied their customers' tastes with greater ingenuity than ever in times of peace, and they had made almost unprecedented efforts in commercial travelling. The President went on to refer to efforts made by our manufacturers to take up industries once in German hands—glass, chemicals, dyes, electrical apparatus, etc. It was more than a mere matter of competition with Germany. It ought to be part of our national organisation to see that there was no essential article, either for the arts of peace or for the arts of war, which could not be obtained within the Empire. Government assistance might do a great deal, but not without the personal ability, training, skill and industry of the individual. He laid it down as one of the first necessities of this country that if she was to hold her own during times of war, and when war was over, we must improve our research methods, the education of our people, and the training of our young men. We should not attempt to economise on the money that we now spent on technical colleges and modern appliances. If our present well-managed banking systems could not be

more adventurous we must have some additional institutions. Commercial banking must play a large part if we were to hold our own against Germany. We must once more overhaul our patent system. The development of new inventions, and the restrictions which we put on their use, may have a greater influence on the extension of our trade and industry than even the juggling of a tariff. The importance of co-operation with the Dominions, the spirit of the Dominions, and the question of foreign shipping competition, were among the other matters referred to by Mr. Runciman in the course of a long speech which is well worth reading from beginning to end by all of our readers who are keenly studying the problems of the present hour. Now, repeated the speaker, Germany was a commercially beaten nation if there ever was such. But the real trouble was, when the war was at an end, she might wish to embark upon a new campaign. In this connection it would be necessary for us in making peace to see to it that she did not raise her head.

Russian Trade.—Speaking on the Russian electrical trade opening, at a meeting of the French Syndicat des Industries Electriques held at the end of last year, M. de Halgouet, commercial attaché at the French Embassy at Petrograd, stated that before the war the Russian electrical industry had become a veritable German monopoly. Three great companies, German in origin, divided the business between themselves. These were the Volta Company, of little importance; the A.E.G., operating at Riga; and the Siemens-Schuckert companies, which were formerly distinct, but were now amalgamated. Owing to this important trust, the Germans had succeeded in securing all the orders. The *modus operandi* of these houses was as follows:—First, they granted long terms of payment; then they had agents, who waited on the Russian manufacturers, studied their wants, and submitted estimates for the carrying out of installations complete to the smallest detail. Furthermore, the Germans had a wonderful acquaintance with the Customs tariffs. In Russian workshops which they opened, they made all those parts which it would cost too much to import; thanks to these measures, it might be said that, in 1913, the Germans monopolised three-fourths of the Russian electrical trade. Of the three German houses, the two principal—the Siemens-Schuckert and the A.E.G.—were constituted with capitals of 15 and 12 million roubles respectively; together they did, in the year 1913, business to the extent of 130 million of francs, of which 40 million only represented goods made locally, and 90 millions were imports by these German houses working under a Russian label. These houses are still operating; moreover, if they were stopped, the whole Russian electrical industry would be stopped too, and as this industry is indispensable for the National Defence, it is impossible to do so. One could, on the other hand, call for the liquidation of these companies if a French group could subscribe the necessary capital, and replace by French importations the German importations made by these companies. To do so, a capital of 50 million roubles would have to be got together, and a similar machine-tool equipment and skilled staff as that possessed by the Germans would have to be forwarded to Russia. . . . . If however, the liquidation of the A.E.G. only were called for, a capital of only 10 million roubles would be required.

In subsequent observations relating to the fostering of French exports to Russia he advocated, as a preventative against bad debts, representation on the boards of Russian electrical concerns, and reaffirmed his statements that the best methods of developing exports towards Russia was to establish on the spot technical bureaux identical with those possessed by the Germans. Russians preferred comprehensive and complete estimates, and, only after their study, were orders placed. The technical bureaux mentioned should have branches, and the most competent agents, in every industrial district. An electrical section might also be attached to the Sales Office which the French Foreign Trade Bureau was about to open, while the Syndicat's affiliation to the French Chamber of Commerce in Petrograd was also advisable in this connection.

To Platinum Dealers.—The Director of Materials at the Ministry of Munitions has addressed the following notice to dealers in platinum:—

"I am directed by the Minister of Munitions to inform you that, in exercise of the powers conferred on him by the Articles of Commerce (Returns, &c.) Act, 1914, pursuant to arrangements made with the Board of Trade, he hereby requires you within three days from the date of this notice to make a return to the Director of Materials of the Ministry of Munitions, Armament Buildings, Whitehall Place, S.W., of the whole of the stock of platinum, ores, residues, or bars containing the same, now on your premises or under your control.

I am at the same time to draw your attention to Defence of the Realm Regulation 30A, and to the Order made by the Minister of Munitions thereunder, and I am to observe that any person buying, selling, or dealing in platinum, or goods manufactured wholly or partly of platinum, offering or inviting an offer or proposing to buy, sell, or deal in it or them, or entering into negotiations for the sale or purchase of or other dealing in it or them, without a permit, is liable to the penalties provided for offences against the Defence of the Realm Regulations.

Birmingham Electrical Volunteers.—We read in the "Birmingham Daily Dispatch" that the first batch of men raised by Mr. W. E. Milns, adjutant of the Birmingham Electrical Volunteers, for engineering work in connection with coast defence, left Birmingham on January 10th. The local corps have been asked by the Admiralty to supply and maintain a section of skilled engineers who are ineligible for military service. Mechanical and electrical workmen of all grades, and also clerks with a knowledge of the engineering trades who are willing to give a week or more to this work, are asked to communicate by letter with Mr. Milns at 14, Dale End, Birmingham. A meeting of all interested in the scheme will be held at the Birmingham Arms, Jamaica Row, at 7.30 p.m. to-day, Friday, at which Mr. Milns will explain the scheme in detail. Those who volunteer will have their train fare paid, billets will be provided, and a small daily allowance will be made.

St. Helens and Enemy Contracts.—A somewhat lengthy discussion took place at a meeting of the St. Helens T.C. on January 5th respecting a proposal to accept the tender of a certain firm for the supply of a water cooling tower. The point of discussion was as to whether or no the firm with whom it was proposed to place the contract was a British firm with British capital, and Ald. Sir John Beecham (chairman of the Electricity Committee) said that inquiries had been made and the committee was satisfied. Some members of the Council appeared doubtful, and Sir John Beecham ultimately accepted a suggestion that the Mayor, the Chairman, and the Town Clerk should find out definitely what the position was. Following the discussion the Mayor (Ald. Bates) moved: "That no contract shall be entered into with any person, firm or company, of enemy nationality." This was seconded by Sir John Beecham, and carried.

The Trade War.—It is announced that, at the request of a large number of business men, the Lord Mayor has convened a meeting for Monday, January 31st, at 3 p.m., to consider the questions of trading and employment after the war. Many organisations will be represented.

The Italian Chamber of Commerce in London has passed resolutions expressing the opinion that it is desirable:—(1) That the Allied Governments should arrive at an agreement to institute a reciprocal preferential tariff, and in that case all goods imported from countries which are not parties to the agreement should plainly indicate their origin. (2) That the shipping and railway services between the Allied countries should be improved and extended, the shipping lines subsidised and granted special facilities, including reduced port and dock fees. (3) That the prineipal commercial laws of the Allied countries should be made uniform to correspond with the needs of international trade; and (4) that for all supplies for, and contracts with, the Allied Governments and public bodies only the Allied countries should be allowed to tender.—"Morning Post."

London Lighting.—Replying to a question in the House of Commons on January 6th, Mr. Hayes Fisher said the President of the Board of Trade was strongly in favour of any economy that could be effected in the electric lighting of London, and he understood that in a very large proportion of the public lamps the candle-power had already been reduced; but in some cases the type of lamp employed was such that to reduce the candle-power would involve a considerable amount of initial expenditure which would be thrown away in so far as it was not recouped by savings before the end of the war. He was informed that the employment of lamps of low candle-power not blacked over would not fulfil the main object of the regulations.—"Times."

Enemy Capital.—In the House of Commons last week a member asked the President of the Board of Trade whether he would publish the list of firms trading in this country influenced by German capital, of which the Public Trustee had official cognisance as supervisor or in any other official capacity, in order that the public might be made aware of the character of the firms with whom they dealt. Mr. Runciman replied: "As at present advised, I do not propose to publish a list of firms with German capital, but legislation will shortly be introduced to confer further powers upon the Board of Trade to take steps in suitable cases to prevent the continuance of businesses carried on for the benefit of enemies."

Petrograd Electro-technical Institution and the War.—The Council of the Professors of the Petrograd Electro-technical Institution has made its lectures free to 121 of the students. On account of the consequent reduction in the receipts, the firm of Erikson has made a gift of 1,000 roubles. On the question of commemorating the death of those connected with the Institution who had fallen in war, it was decided to decorate the lecture hall with black and white marble slabs. On the black slab will be inscribed the names of all those students who have fallen in the war, and on the white slab the names of those who have distinguished themselves in battle.

Australian Councils and British Preference.—A Melbourne paper says that in his report to Hawthorn Council in November, as delegate on the Prahran-Malvern Trust, the Mayor (Councillor Russell) stated that in accepting tenders for overhead equipment for the Burke Road and White Horse Road tramways the Trust had given preference to a British tender as against an American one. Councillor Russell added that, as far as he was concerned, he would carry out this policy in every case. He trusted that after the war was over municipalities and public bodies would continue the practice of always giving preference to British goods over American.

A New Canteen.—At a certain very progressive and well-known electrical instrument factory not very far from London, where a variety of instruments for the Government are being made, the Y.M.C.A. has organised a canteen for the convenience of the workers, on lines similar to those followed at Woolwich and other industrial centres, but, of course, on a smaller scale. Mrs. Winston Churchill, who is actively engaged in this branch of Y.M.C.A. work, enlisted the sympathetic assistance of a staff of local ladies, and she opened the new building with an address to this voluntary staff of about thirty ladies. The proprietor of the works expressed the gratitude of the working staff for the assistance rendered, which made it possible to provide the good food which was necessary to enable good work to be done. He briefly demonstrated a few of the instruments which were being made at the works. He also said that much of the work was already being done by young women, and that there was scope for many more in such work, even after the war.

Recruiting Notes.—It was reported to the Tunbridge Wells T.C. that the whole of the eligible staff at the electricity works had applied to be attested under Lord Derby's scheme. Five had been rejected and nine accepted. The Council has decided to apply to the tribunal for the retention of the nine men as being indispensable for the maintenance of the undertaking.

The number of men connected with the electrical department of the Great Western Railway who are now serving with the Colours, is 71, this being 25 per cent. of the staff. From the same department no less than 125 have presented themselves for attestation under Lord Derby's scheme.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Horn-Gap Fuses.

Reading the note on horn-gap fuses which appeared in our last issue, the ELECTRIC AND GENERAL WORKS, LTD., of 15, Victoria Street, London, S.W., noticed the resemblance of the apparatus to one which they supply, and which has been on the market for a number of years. The accompanying figure shows one of their triple-pole horn-gap fuses for mounting on a transmission-line pole in the open; it will be noted that the horns are precisely of the form advocated, and, in fact, the company's works, which claim very special experience extending over many years in all types of horn-gap switchgear, have been making all their horns in this form for some time past.

In the example illustrated herewith, the horns consist of $\frac{1}{16}$ in. copper wire and are very easily renewable. The fuse-strip consists of pure silver wire, which the makers find gives by far the best results, as it is to a great degree unaffected by climatic conditions, and the fusing point remains much more constant than in the case of copper. It also blows far more quietly. A great advantage of the design consists in the fact that the fuse-strip is not attached to the horns themselves, but is supported in substantial terminals immediately below the gap. In this way the wear and tear of the metal forming the horns at either side of the gap is reduced to a minimum, the life of the horns being thus greatly lengthened, so that renewal, or any attention at all to the horns, is rarely necessary. The replacing of the fuse-strip, which is not enclosed in any way, is also greatly simplified. These horn-gap fuses are supplied for pressures ranging from 4,000 to to 35,000 volts, and for currents up to 200 amperes.

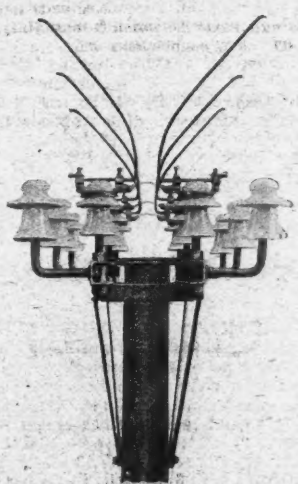


FIG. 1.—TRIPLE-POLE HORN-GAP FUSE.

New Insulated Lampholder.

We have received from MESSRS. ST. JOHN DAY (PATENTS), LTD., of Mumps Electrical Works, Oldham, particulars of a new insulated lampholder of extremely simple design, constructed throughout of Oldamit insulating material, with the exception of the contact making plungers and wiring terminals, which latter are wired on the firm's "one part" principle.

The holder consists of three main parts, viz., the body in which are inserted the two one-piece contact plungers and wiring terminals, with an insulating partition between the latter; a nipple which screws into the upper end of the holder, and through the centre of which the flexible passes; and a "combined shade ring and lamp support," which is screwed on to the lower part of the body, and, a shade being slipped over the body first, takes the place of the ordinary shade ring. At the same time the lower portion of this ring is provided with internal groves to form the lamp socket, the groves being in the correct relative position to the plungers, when the ring is screwed up.

FIG. 2.—INSULATED LAMPHOLDER, WITH COMBINED SHADE RING AND LAMP SUPPORT.

Independent adjustment of the shade fixing can be obtained by a separate ring screwed on the outside of the combined shade ring and lamp support, and an insulating hood, or petticoat, can also be provided, if desired.

FIG. 3.—LAMP SUPPORT IN POSITION.

By slightly turning the combined shade and lamp support in a left-hand direction, and thus disconnecting the lamp contacts, the device can be used as a switch-holder, and a limit stop is supplied, if desired, for this purpose.

An improved design of the same kind is being made in which the switch break takes place in the body with an insulating wall between each pole. The holders are made in various qualities of material to withstand heat, gases, acids and rough usage, and are covered by several patents.

LEGAL.

POWER SUPPLY USED FOR LIGHTING.

AT the Halifax Police Court, on January 7th, J. W. Scott, motor engineer, pleaded guilty to a charge of having fraudulently consumed electricity at his premises, and was fined £5, including costs. Electricity supplied at 2d. per unit for power purposes had been used for lighting, whereas the lighting rate was 4d. It was stated that defendant had offended unwittingly, the wiring having been done by a former employé, who should have known that it was improper. Defendant had now offered to pay the Corporation at lighting rates for all the electricity he had used during the past year.

Sending Electric Batteries to Amsterdam.

In the City of London Court, on January 7th, before Sir John Paget, Bart., K.C., Deputy Judge, Van Oppen & Co., Ltd., carriers, 90 and 91, Bartholomew Close, E.C., claimed £5 12s. 11d. against Mr. A. France, 79, Shaftesbury Street, New North Road, electrician, for shipping charges in taking 4,000 electric batteries from London to Amsterdam. Mr. Gibson appeared for the plaintiffs, and Mr. Gowing for the defendant.

Mr. Hubbard, plaintiffs' dispatch clerk, said that they carried the goods under a consignment note. They were refused by the consignees in Amsterdam, and had to be brought back. That involved the payment of duty in Amsterdam, Customs charges, &c.

Defendant told the Court that he bought 5,200 batteries in Amsterdam. Only 1,200 were good ones, and the rest were bad. Consequently he engaged the plaintiffs to take back the 4,000 bad batteries and collect good ones in their place. Plaintiffs did not do that. Therefore they were entitled to nothing. It was ridiculous to suggest that duty was payable in Amsterdam on goods which were manufactured in Holland.

The Deputy Judge thought the defendant's suggestion a very unreasonable one, seeing that the plaintiffs would not get paid anything if they could not get the good batteries in exchange. Mr. Gibson: And the firm in Amsterdam have gone bankrupt. That is why we could not get the good ones. Defendant said that was not so. In cross-examination he said that he did not sign the consignment note. It was signed by a German who had since been interned. Many firms took out goods to Holland to exchange them, and were paid nothing unless they brought back the goods. The Deputy Judge did not think the plaintiffs would enter into such a silly contract as was suggested by the defendant. It was very improbable.

Mr. Gibson: No firm of carriers would be able to carry on business if the defendant's view were to prevail.

The Deputy Judge found for the plaintiffs, with costs. Mr. Gowing asked for leave to appeal. Plaintiffs had been guilty of a breach of duty, and it would mean a serious loss to the defendant. The Deputy Judge refused leave, and said that the consignment note was dead against the defendant.

Urban Electric Supply Co.'s Appeal.

The Lands Valuation Appeal Court (Lords Salvesen, Mackenzie, and Cullen), sitting in Edinburgh, disposed of an appeal by the Urban Electric Supply Co., Ltd., who appealed against the valuation of their electric works and mains in the burgh of Hawick. The works at 20, Commercial Road, Hawick, were entered in the roll at £1,210, and the mains in the burgh at £1,210, and the appellants claimed that the valuations should be reduced to £590 each. It was stated that the parties were agreed that the "profits principle" should be the basis for calculating the assessed rent. The Burgh Valuation Committee reduced the valuation by £121 to £2 300 for works and mains.

The Court affirmed the determination of the Valuation Committee except to the extent of £25, which was allowed as a further deduction from the valuation.

Lord Salvesen said the most important question was as to whether certain machinery, which was *de facto* in its nature heritable, and was used for the purpose of supplying motive power, must, nevertheless, be included in the tenants' capital, so as to reduce the assessable value of the buildings belonging to the company. His Lordship was clearly of opinion that that claim was excluded by the Valuation Act. The machinery consisted principally of superheaters and mechanical stokers, and was used for the purpose of producing or transmitting first power, and although these might affect a certain saving in the labour bill, they could not be regarded otherwise than as heritable. Another question was whether the tenant was entitled to include in tenants' capital a sum of £500, which he kept in the bank to meet current expenses, and which earned no interest. The tenant required that sum to carry on his business, and accordingly was entitled to a deduction of £25, being at the rate of 5 per cent. A third point dealt with the claim of the appellants that four months' extra stock of coal should be treated as part of the necessary capital of the tenant. His Lordship was of opinion upon the facts that that extra stock was not necessary. The Assessor had already allowed for five months' working expenses, which included the cost of coal for five months, and the appellants claim that nine months' supply was a minimum had not been proved.

Lords Mackenzie and Cullen concurred.

Electrical Engineer's Claim.

In the Court of Session, Edinburgh, a settlement has been effected in the action pending before Lord Anderson, in which James Kyle, electrical engineer, 3, Crichton Place, Edinburgh, sued John M. Roger, Balgrove Farm, St. Andrews, for payment of £700 as damages in respect of personal injuries. The pursuer was serving as a dispatch-rider in the Lothians and Border Horse, and was stationed at Ceres. On September 14th, 1914, he was riding a motor-cycle towards St. Andrews, when, near the village of Dairsie, he was run into by a motor-car belonging to, and driven by, the defender, coming in the opposite direction. He was severely injured. The defender denied fault, and alleged several faults against the pursuer in driving his cycle. The case has now been settled by a payment to the pursuer of £100 and expenses, and the action has been taken out of Court by joint minute.

Workmen's Compensation Claim.

In the City of London Court, on January 10th, before his Honour Judge Atherley-Jones, K.C., a claim was made by a labourer, named George F. Ling, against Messrs. Babcock & Wilcox, Ltd., water-tube boiler makers, to recover damages under the Workmen's Compensation Act for injuries received while working for them. Mr. Rowe appeared for the plaintiff and Mr. Harold Morris for the defendants.

Mr. Rowe said that the plaintiff sustained severe injuries in July. He was employed by the defendants at the London and South-Western Railway Co.'s generating station at Wimbledon. They were putting in boiler tubes, and the method of lifting them was to use a piece of wood. The wood slipped in one instance, and the tube fell, cutting off a piece of the plaintiff's left ear, and bruising his head and face. He was taken to the hospital, where he remained a fortnight. During his illness he was paid 15s. a week half-wages and now he was paid full wages. Plaintiff was fit to work and might be discharged. Then plaintiff would have no remedy under the Act unless the Court made an order.

Mr. Morris urged that no dispute had arisen; therefore the Court had no jurisdiction. Plaintiff was only entitled to a declaration of liability, and that had never been asked for. He was still getting his full wages.

The Judge said that the plaintiff would have a declaration of liability and costs. If he got worse he could come back.

Thermit Welding.

An application was made before the Patents Court on January 5th, by the British Thermit Co., of the Albany, Liverpool, for a licence to use eight patents owned by Thermit, Ltd., of London, alleged to be necessary for carrying out the Thermit process of welding the joints of rails.

Mr. E. R. Royston, patents agent, of Liverpool, appeared for the applicants, and Mr. Colefax, K.C., and Mr. Hunter Gray for the opponents.

Mr. Royston said that Thermit, Ltd., was a company registered in England, but with German shareholders. It was now a controlled establishment with a supervisor appointed by the Government. He urged that an alien company could not be allowed to remain in possession of the patents, and contended that in view of the advantageous position of the opponent company, any royalty should be very small.

Mr Colefax, in addressing the Court in opposition to the application, referred to the rules laid down in the Act of 1914.

The Controller said it would take a good deal to convince him that it was not in the interest of the community that an independent, purely English company, in which the profits went to English shareholders, should be set up. The object of the whole of this legislation was that English trade might be fostered.

Mr. Turner, the managing director of the British Thermit Co., Ltd., giving evidence, said that it was practically impossible to go on any further in view of the patents held by the competing company. If the applicants had a licence to use these patents, they would be able to weld tramway rails for corporations themselves. At present they could only sell Thermit, and corporations did not give them orders because they could not weld the joints, owing to the patents held by the opponent company.

Mr. Colefax submitted that the needs of the country were satisfied by Thermit, Ltd., that there was no ground for apprehending that there would be a scarcity of the material, and that the applicants were entirely incapable of doing the work.

In the case of a licence being granted, he suggested a royalty of 2s. per joint as against 6d. suggested by Mr. Royston.

The Court reserved its decision.

BUSINESS NOTES.

Norwegian Nitrogen.—The report for 1914-15 of the Norwegian Nitrogen Co., which is a Franco-Norwegian undertaking, states that the increase in the turnover kept pace with the development of the production; the profits correspondingly experienced an expansion, and the further progress of the company is regarded with optimism. The net profits, which amounted to £275,000 in 1913-14, rose to £399,000 in the past year, and the dividend proposed on the ordinary share capital of £3,188,000 is at the rate of 7 per cent. as compared with 6 per cent. in 1913-14, the preference shareholders receiving 8 per cent.

Patent Restoration.—An order has been made restoring Letters Patent No. 16,237 of 1910, granted to Henry Norman Leask for "Improvements in charging doors for furnaces."

New Industries in the U.S.A.—According to a Reuter telegram, a company has been formed in the United States to manufacture nitric acid by extracting nitrogen from the air, with the aid of water-power in Canada, near Lake St. John and on the Saguenay River.

The manufacture of quartz glass from sand deposits found in the State of Nebraska has been developed on a large scale, owing to the cessation of importations from Germany.

Bankruptcy Proceedings.—Augustine Garbutt, "electrical engineer, now weighing-machine attendant," Leeds.—First meeting January 14th; public examination, February 1st; both at Leeds.

Trade Announcements.—Mr. A. G. Ingleby, late of the machinery department of the Adnil Electric Co. has joined the Electrical Supplies Co., of Tottenham Court Road, W., in order to take charge of their engineering department. This department has been reorganised. The company is now representing the following in London and the South of England:—The Keighley Electrical Engineering Co., Ltd., for A.C. motors and dynamos up to and including 125 H.P., and Messrs. Firth & Russell, of Leeds, for A.C. motors up to 100 H.P.

Messrs. Cave & Higgin, Ltd., have removed into their new premises at 265, Deansgate, Manchester. (Telephone: Central 1283.)

Messrs. A. J. Greenly & Theodore Denison have taken over Baldwin & Wills works, St. Albans Road, Watford, and commenced business as manufacturing electrical and mechanical engineers, under the style of Greenly & Denison, with offices at 37 and 38, Strand, W.C. The firm are in a position to do small turning, boring, screw-cutting, and other work. The Greenly Advertising Service will be carried on by Mr. Greenly as heretofore.

The Chloride Electrical Storage Co., Ltd, of Victoria Street, London, S.W., intimate that their telephone numbers are:—442 and 443 Victoria. Some of their friends continue to call up numbers that were discontinued some time ago.

Liquidations.—South Wales Wireless Training College, Ltd.—This company is winding up voluntarily with a view to reconstruction. Mr. G. F. Willett, 92, Queen Street, Cardiff, is the liquidator, and a new company known as the South Wales and West of England Wireless Training College, Ltd., is to be formed.

Empire Portland Cement Co., Ltd., Northfleet, Kent.—A meeting of the committee of creditors was held on January 5th, and adjourned until January 13th.

British Metal Engraving Co., Ltd.—A meeting is called for February 11th, at 3, Warwick Court, Gray's Inn, W.C., to hear an account of the winding up.

Parana Power Syndicate, Ltd.—Creditors must send particulars of their debts, &c., to Mr. L. Maltby, 4, London Wall Buildings, E.C., the liquidator, by February 1st.

Catalogues and Calendars.—Messrs. Stewarts and Lloyds, Ltd., of Winchester House, E.C., have again favoured us with one of their white and gold wall calendars, with the flags of the Allies artistically inset above the monthly date cards.

Messrs. Mather Bros., of 35 and 36, Farringdon Street, London, E.C., have issued a wall calendar with monthly sheets for 1916.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have sent us one of the admirable pocket diaries which have become identified with their name—a pocket-book which in shape, size and make-up, is, perhaps, the most handy and useful that we know of. With it comes a novelty in the form of a "cable capacity gauge"—a set of hinged brass disks, perforated with holes exactly corresponding with the internal diameters of the eight sizes of Simplex heavy-gauge conduit. A set of cards is provided, showing the outlines of 12 sizes of insulated cable packed close together, and, by placing the gauge over the appropriate diagram, the maximum number of cables of a given size that the conduit will contain is at once ascertained. The gauge and cards are provided with a neat leather case for the pocket, and should prove extremely useful to contractors.

Messrs. Turner Bros., Rochdale.—Twenty-page publication showing reproductions of a series of advertisements, which have appeared in the Press, of their asbestos and other goods.

Messrs. Berry, Skinner & Co., 78, Upper Thames Street, London, E.C., have prepared an embossed metal perpetual calendar, the metal work of which is made to a design around an archway through which is seen an illustration of one of the firm's "Ironsafe" switchboards.

The Steel Tubes and Conduits Co., Alice Street Works, Keighley.—Twenty-four-page illustrated catalogue giving particulars and prices of their conduits and fittings for electrical purposes, including "Spring" inspection fittings, "Stacc" grip fittings, tees, couplings, bends, circular junction boxes, cast-iron universal boxes, and sundries.

Rugby Lamp Co., Ltd., Rugby.—Illustrated price list of "White Star" metal-filament and "Rugby" carbon-filament lamps.

Messrs. Ferranti, Ltd., Central House, Kingsway, London, W.C.—List Hb. 145 gives a description and tabulated sizes, weights, capacity, prices, &c., of their type Wb electric water-heater.

Messrs. C. J. Edwards & Son, Ltd., of 32-34, Great Sutton Street, Clerkenwell, E.C., have prepared a large hanging calendar-sheet for 1916, with the dates for the year very clearly set out, also a list of engineering stores stocked by them.

Electric Horns.—The Benjamin Electric, Ltd., of 1A, Rosebery Avenue, London, E.C., have issued a circular embodying a special New Year's offer to the trade of Benjamin electric motor horns.

LIGHTING AND POWER NOTES.

Aberystwyth.—Fire.—According to the *Times* a fire occurred on the switchboard at the electricity works on Monday, which it was expected would result in shutting down the electric supply for two days.

Argentina.—It is proposed to form a local co-operative electric light and power society in Mar del Plata, with a capital of $500,000 m/n.

After allowing several extensions of time to the municipal authorities for payment of a debt of $22,000 m/o. for electric lighting, the local electric light company of San Antonio de Areco cut off the current. The general public who pay their rates and taxes punctually are disgusted at the awkward situation the municipal maladministration has placed them in.—*Review of the River Plate.*

Ashtead.—Street Lighting.—With regard to restricted lighting, the Leatherhead Electricity Co. has pointed out to the P.C. that the greater part of the cost of the street lighting was made up of interest and sinking fund charges on the mains and fittings, and that, although if the lamps were not used a certain amount of fuel was saved at the E.L. station, the fixed charges remained just the same. It was also pointed out that the present contract terminated next May, and the company had no assurance that it would be renewed, and it might be compelled to disconnect all the mains and fittings. The company offered to discuss a reduction in the charge for the present year when the lamps were not used for the full time, at the same time it discussed the question of the contract for the lighting for the next five years. The Council has decided to renew the request for a rebate.

Attleborough.—E.L. Scheme.—The promoters of an E.L. scheme for this parish have applied to the Eastern Highways Committee of the Norfolk County Council for permission to erect poles for overhead wires, and sanction has been withheld pending a report from the county surveyor.

Australia.—The Mount Gambier (S.A.) Corporation agreement with Messrs. Bridger, Ltd., for the supply of electricity to the town is for a term of 10 years, at the conclusion of which the Corporation is to have the option of purchasing the plant. It is expected to have the scheme completed by the end of 1916, when the agreement with the Colonial Gas Association expires.

The proposal to utilise the water supply system of Grafton and South Grafton (N.S.W.) in connection with a hydro-electric power scheme has been adopted by the Councils. The scheme is estimated to cost £23,000.—*Tenders.*

The Melbourne City Council has decided to give a H.T. supply to the mining school in connection with the research work into the manufacture of high-speed tool steel.

In connection with the lighting of St. Kilda's Road, it is stated that the Electric Supply Committee will shortly have before it a big scheme for the lighting of this thoroughfare.

Electrical Pumping.—The Works Committee of the Brisbane City Council reported on a scheme for providing water for the city baths, street watering and drain-flushing purposes. It was suggested that the proposed reservoir on the crest of Spring Hill should be supplied with water from the river by a turbine pump installed on the river bank, with a capacity of about 650 gallons a minute. It was estimated that the cost of the pumping station and main would be about £1,900. The City Electric Light Co. had offered to supply power for pumping at 1·06d. per unit provided the pumping was carried out between 11 p.m. and 7 a.m. The engineer estimates that the price worked out at 1·20d. per 1,000 gallons for pumping, which, together with working expenses, would not exceed 1·5d. per 1,000 gallons pumped. It was pointed out that the authorised loan for the work was £13,000, but the estimate was made in 1910, and that the extra cost of labour and material and the extended nature of the scheme now submitted must be taken into consideration. The City Council adopted the report.—*Tenders.*

Bacup.—Loan Application.—The T.C. has decided to apply to the L.G.B. for sanction to a loan of £300, for the purpose of supplying electricity to a new factory.

Birkenhead.—Price Increase.—The Electricity Committee of the T.C. has decided to increase the charge for current to ordinary consumers for lighting and power from the New Year by 7½ per cent.; and to pre-payment meter consumers by ½d. per unit.

Bolton.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £2,000 and £215 by the T.C. for the supply of electrical energy to Messrs. W. A. Openshaw, Ltd., Hill Fold Mills.

Bo'ness.—Proposed Extension.—At a special meeting of the T.C., on Friday last, a letter was read from the National Electric Construction Co., requesting consent to a permanent extension of the burgh electricity works in place of the proposed temporary extension recently approved by the Secretary for Scotland. Plans and specifications of the new works, submitted by the company, showed that the proposal was to introduce a 500-KW. steam turbine set, together with an extension of the power station and other additions estimated to cost, in all, about £10,000. The company stated that the proposed extensions were imperative to meet the demands upon the station. The Council, after consideration, agreed to call in the services of an independent engineer to report on the state of the works and the necessity for the extension.

Burnley.—Insurance.—The electrical engineer having reported that he does not consider the plant of the electricity department sufficiently insured against damage by fire, the Electricity Committee has resolved to obtain a covering note for a further £20,000 on the plant in the main generating station, sub stations and substation buildings, and to obtain tenders for the valuation of the whole plant installed at the electricity works, with a view to re-arranging the insurance against damage by fire.

Brandon and Byshottles.—STREET LIGHTING.—The Council is considering a letter from the Brancepeth Coal Co., requesting payment in full of its street lighting account. It was reported that three collieries had accepted the Council's basis that lighting should only be paid for according to the actual hours of burning, but the Coal Co. had returned the account, and pointed out that it had put down machinery and plant, was having to pay increased wages, and that the cost of coal for supplying current had advanced.

Bath.—HOSPITAL LIGHTING.—The electrical engineer reported that the Bath War Hospital was to be lighted with electricity, and for that purpose it would be necessary to extend the H.T. main from the sub-station at Portway works, at a cost of £170. The Mayor had authorised him to make an offer to supply electricity at a flat rate of 4d. per unit. The Electricity Committee recommends that this offer be confirmed, the work required be put in hand at once, and that the War Office be requested to erect the building required for the sub-station at the hospital.—*Bath Herald.*

Continental.—RUSSIA.—The Minister of Trade has submitted proposals to the Moscow authorities for reduced electric lighting and early hours for theatres, the owners of which, however, prefer later hours with fixed duration of performance. Warehouses must cut off current by 7 p.m., and restaurants must reduce their light by 30 per cent. compared with the previous year. Cinematographs are to have four hours per day, like the theatres, but double time on holidays. The T.C. has replied, objecting to the proposals, and suggesting decreased current supply, so that the use of improved lamps would help. The Council has already reduced the current supplied in the town thoroughfares.

In Tula, incandescent lamps are being used in place of arc lamps, owing to lack of carbons.

The Karkoff Electric Station Bureau has submitted an estimate to the T.C. for changing over from gas to electric lighting.

Cuba.—With a view to displacing three stations of insufficient capacity, there has been erected in Havannah a single large plant capable of supplying the current required for lighting, power and traction. The equipment of this station comprises three groups of turbines, of 12,500 KW. each. The current is generated at 2,200 volts, and distributed at 6,000 volts, and 220 volts, according to its application. The installation of a fourth group of plant is in contemplation.

Dewsbury.—PLANT EXTENSION.—The T.C., on Thursday last week, considered a proposal of the Electricity and Tramways Committee to purchase a secondhand generating set from Dumbarton and install it at an estimated expenditure of £3,000, the money to be provided out of the profits of the undertaking. There was a lengthy discussion on the matter. The chairman of the Electricity Committee explained that the present plant at the electricity works was working very near to the margin of safety owing to heavy demands, and a breakdown would be a serious matter. The proposed purchase was only a temporary expedient. The Committee's proposal was approved. The Council also approved a recommendation that the present charges for electricity be continued until further notice.

Dinas Powis.—The Bishop's Palace at Llandaff is being rebuilt and will be lighted throughout with electricity generated upon the premises. It has not yet been decided whether the improved lighting of the Cathedral shall be by gas or electricity.

Mr. R. H. Fletcher (of Messrs. Lewis & Fletcher, electrical engineers, Cardiff), has been appointed consulting engineer for the electrical undertaking of the District Council.

Hawick.—RATING APPEAL.—The Urban Electric Supply Co., Ltd., appealed against the valuation of the electricity works and mains in the burgh, which were assessed at £2,420, and which the Burgh Valuation Committee reduced to £2,300. The Court affirmed the valuation of the Committee, less £25, which was allowed as a further deduction from the valuation.

London.—BATTERSEA.—The Electricity Committee reports that the work of linking up the electricity supply undertakings of Battersea and Fulham has almost been completed, and that satisfactory tests of the cables have been made. The Committee recommends that it be authorised to arrange for the supply of electrical energy from and to the Fulham Council as and when required.

HACKNEY.—The Electricity Committee reports that the 3,000-KW. Willans turbo-alternator set has undergone official tests. The borough electrical engineer has been authorised to place an order with Messrs. Ferranti for a grid-type earthing resistance of 200 amps. capacity for three minutes, at a cost of £105.

Lynton.—STREET LIGHTING.—The Electricity Co. has informed the P.C. that it is not in a position to make any substantial rebate on the cost of public lighting, solely on the ground that the lamps are extinguished early, as this does not reduce the cost of maintenance to any marked extent.

Luton.—COAL PRICES AND EXTENSIONS.—The town clerk is in communication with the B. of T. in reference to matters relating to the electricity coal contract. The contractors state that the pitmouth prices for Ibstock coal for the year ended November 30th, 1914 were at 7s. per ton, and for the 12 months ending November 30th, 1916, 13s. 3d. per ton. The colliery proprietors contend that they were entitled to 13s. 3d. as being only 4s. per ton in excess of the average price received by them during the year ended June 30th, 1914, and that they are not restricted by the Price of Coal Act to 4s. upon the actual price paid by any one purchaser. The L.G.B. has advised the Electricity Committee that it is prepared to sanction loans, amounting to £27,790, on being furnished with a copy of a resolution of the Council in respect of the difference (£2,140) between that sum and £25,650, the amount of the original application. The Board states that it has deducted from the total amount (£30,327) the sum of £2,537 remaining unexpended on account of the loan of £5,000 sanctioned in August, 1913, for general extensions of mains, as it considers that this balance should be used towards defraying the cost of the mains now proposed to be laid in connection with the present scheme for additional plant. The full amount for the proposed new cooling tower would be sanctioned on condition that the outstanding debt on any of the depôt buildings which may have to be pulled down will be paid out of the reserve fund. The Electricity Committee proposes to reply to the Board's remarks to the effect that it has erroneously deducted the £2,537, as the £25,650 represented the net cost after deducting the first-mentioned figure; and to remind it that in November last the Council undertook to pay out of the reserve fund any outstanding loan debt on any of the depôt buildings, which will be demolished or interfered with by the new cooling tower. The Council, therefore, again requests the Board to sanction the £30,327 originally applied for. The Committee also proposes to apply for sanction to borrow the additional sum of £4,677, being the difference between the amount of the original application (£25,650) and the £30,327 asked for. Subject to the requisite order being granted by the B. of T., the Electricity Committee has asked the Council to agree to a supply of energy being given to the premises of Messrs. Hewlett & Blondeau. The agreement will provide for a fixed period of 14 years, determinable at the end of the seventh year, and for the payment by the company of a total minimum sum of £1,750 during the first seven years.

Middlesbrough.—CHEAP ELECTRICITY.—The Corporation has agreed to a request by Mr. Gridley, of the Cleveland and Durham Electric Power Co., who suggested that in the case of seven of the company's officials whose duties require them to reside in the town, a deduction should be made by the company from the Corporation's bill in respect of energy supplied to the residences of these officials in order to give them the same facilities for obtaining energy at a nominal rate, which they would enjoy were they able to get current direct from the company's mains. Eight units for every lighting unit and two units for every heating unit used by the officials are to be deducted from the Corporation's account.

Newport (Mon.).—PLANT EXTENSION.—It is proposed to establish a factory at Maesglas, and, according to the report of the electrical engineer, it is desired that the Corporation should provide certain electrical equipment costing about £3,170, or alternatively, about £4,450. The engineer has submitted the proposed terms of agreement, providing for the payment to the Corporation at the termination of the period of supply, of certain amounts in respect of the equipment to be furnished, and the Electricity Committee has decided to instruct the engineer to order the necessary cable and plant and other equipment when he has been informed that the terms of supply were approved.

Nuneaton.—LOAN SANCTION.—The T.C. has received from the L.G.B. sanction to a loan of £6,000, less £778 received for the sale of a 200-KW. set, for extensions to the plant at the electricity works, and has suggested that expenditure for mains and services should be met out of the unallocated balance of profits of the undertaking.

Philippines.—A hydroelectric central station is about to be established at Lucban, in the Province of Tayebas. The estimated cost of the station is 150,000 pesetas. The machinery will be American, and the constructing and working company, organised by the municipality, will be formed with Philippine capital. The power will be obtained from a waterfall on the River Pagsipi, which belongs to the municipality. Lucban is one of the centres of the Philippine hat industry.—*Industria e Invenciones.*

Reigate.—STREET LIGHTING.—The T.C. has referred back to the Highways Committee a recommendation that the E.L. Committee should allow a reduction at the rate of £1 6s. per annum for all street lamps not lighted from October 23rd, and so long as the lighting restrictions remain in force.

Rugeley.—PROV. ORDER.—The Rugeley Gas Co. has informed the U.D.C. of its intention to apply to the B. of T. for a prov. order to supply electrical energy for public and private purposes.

San Domingo.—The need for the erection of a new electric light station has been felt for some time in this city, the local Press having made frequent references to the deficiencies of the existing lighting arrangements. In June, 1914, the municipality signed a contract with a certain Senor Michelena, who proposed to start a company to supply the city with electricity. In March last, however, this contract was cancelled for various reasons, and a municipal committee appointed to study measures for the provision of the public services. A practical preliminary step already taken is a resolution to raise a loan for the installation of the new central station.

Sheffield.—The offer of the electric supply department to provide for £185, the necessary switchboards and fittings for charging the electric vehicles of the Health Department has been accepted. The superintendent of the Heeley Health Department depôt has received instructions to extend the electric lighting in those buildings now lit by gas, the supply pipes of which are worn out. The Electric Supply Committee has undertaken to bear the annual charges in respect of the expenditure incurred in laying a new feeder cable from Kelham Island to Newhall Road; mains are to be extended to various parts of the city at an estimated cost of £5,910. The L.G.B. has sanctioned the borrowing of £2,500 to cover the cost of increasing the accommodation for coal storage at the Neepsend power station, and the installation of coal-handling plant, &c., and £1,200 for the provision of rails, &c., crane track, sleepers, and reinforced concrete retaining walls. The Committee has decided to lease a piece of land for the erection of an electric furnace, and has granted permission to place three 150-KW. transformers in the Forncett Street sub-station for operating the furnace.

L.G.B. INQUIRY.—Notice has been given that an inquiry will be held on January 21st into the application of the T.C. for a prov. order to authorise the transfer of the Kelham Island power station from the tramways to the electric lighting department, and to amend any Acts as may be desirable.

Stockton-on-Tees.—BULK SUPPLY.—The Corporation has ordered a new rotary converter for the electricity works, to enable a larger supply to be obtained from the Cleveland and Durham Electric Power Co. The engineer reports that the saving in capital expenditure in providing rotaries, as compared with new steam generating plant and the extension of the buildings, will fully warrant the change. There will also be a saving due to the present increased price of coal.

Swansea.—The Committee has adopted a recommendation of the borough electrical engineer (Mr. J. W. Burr) to dispose of two sets of engines and dynamos at the works, which would leave sufficient space for the installation of a 3,000-KW. turbine; the alteration would also benefit the staff, which, owing to enlistments, is now overworked.

It was decided to extend the mains to the new public elementary school, at a cost of £800, providing the Education Committee paid the interest and sinking fund on the cost of the extension for five years, in addition to the annual charges for current consumed.

South Shields.—PROPOSED LOAN.—The T.C. has adopted the recommendation of the Electrical Committee that application be made to the Treasury and the L.G.B. for sanction to borrow £1,000 to carry out a scheme for the hiring out of motors, and £850 for a motor wagon.

St. Annes.—Mr. J. H. Clothier, the electrical engineer, reports a continued falling off in supply for lighting and traction, which is, however, more than compensated for by heavy increases in supply for both industrial and domestic power. In regard to coal, the engineer says the question is causing great anxiety; although he has sent out a number of inquiries, up to the present he had not been able to secure a renewal or offers for any quantity, with the exception of a 100-ton lot.

Torquay.—The T.C. has been informed that the L.G.B. has consented to an extension of plant at the electricity works.

Walsall.—NEW PLANT.—The Electricity Committee reports that tenders have been obtained for a turbo-alternator set to replace the commandeered plant, and that it had given instructions for the sale of certain obsolete plant. Instructions have also been given for a further reduction in the public lighting, by about 300 lamps, and in this connection the borough surveyor has been authorised to negotiate with the electrical engineer as to the replacement of the high-power electric lamps in the centre of the town by metallic-filament lamps of lower power.

Watford.—STREET LIGHTING.—The U.D.C. has adjourned consideration of the question of public lighting until immediately after the current financial year, but in the meantime, £2,500 is to be paid on account for the year to the Electricity Committee.

Wigan.—The Electricity Committee reported that it had purchased 16,000 tons of coal from the Bryn Hall Colliery Co., at 14s. 6d. a ton, as compared with 11s. 6d. paid to the same firm in March last. This quantity, it was stated, would provide for the requirements until about next Christmas.—*Wigan Observer.*

Wolverhampton.—LOAN APPLICATION.—The Electricity Committee proposes to apply to the L.G.B. for sanction to borrow £1,780 for mains extensions and for permission to spend £670 out of the loans already raised in connection with the above extensions.

TRAMWAY and RAILWAY NOTES.

Batley.—The T.C. has instructed the town clerk to write to the Yorkshire Electric Tramways, Ltd., protesting against the recent increase in fares on the Batley to Dewsbury section of its line.

Bolton.—Through running from Bolton to Clifton, through Farnworth and Kearsley, on the Corporation and South Lancashire tramway systems has been discontinued, the passengers having to change cars at Moses Gate. Representations are being made to the responsible authorities for the re-establishment of the service which has been in operation several years.

Bolton-on-Dearne.—LIGHT RAILWAY APPLICATION.—The new application promoted by the Dearne Valley Light Railway Board for power to construct light railways between Wath-upon-Dearne and Bolton-on-Dearne is to form the subject of an inquiry by the Light Railway Commissioners at the end of this month.

Bournemouth.—LOAN SANCTION.—The T.C. has received the consent of the B. of T. to borrow forthwith up to £6,000 for the reconstruction of a portion of the tramway track at Constitution Hill between the borough and Poole.

Bradford.—FEMALE LABOUR.—The Tramways Committee has decided that, in accordance with the recommendation of the general manager (Mr. C. J. Spencer), instructions be issued to make arrangements for a certain number of women conductors, and that one or two routes be experimented with; that the rate of wages and the hours of duty be the same as for male conductors, with the exception of longer meal reliefs; and that the necessary uniforms be purchased and other essential equipment for such experiment be immediately put in hand; and that all women be dispensed with at the conclusion of the war on the return of the former male employés, or as soon as sufficient male labour can be obtained. It has also been resolved that no women who are engaged in productive employment in the textile trade shall be employed as conductors.

In view of the exceptional conditions prevailing in regard to the employment of women, owing to the war, the Tramways Committee has given authority for increasing the maximum wages of the female staff at the tramway offices from 20s. to 30s. per week.

Burnley.—The manager of the Corporation tramways reports a shortage of drivers and has been authorised to ask the recruiting tribunal for the retention of tramway drivers attested under Lord Derby's scheme. It was reported that the Postmaster-General desired to transfer the carriage of mails from the tramways to the railway company, and desired the present agreement to end. The Committee resolved that the application be not acceded to.

Gateshead-on-Tyne.—TRAMWAY RECONSTRUCTION.—At a meeting of the T.C. on the 5th inst., the Town Improvement Committee reported on the application of the Gateshead Tramway Co. for leave to substitute span-wires suspended from poles placed at each side of Durham Road, from Shipcote to Low Fell terminus, in place of the existing bracket construction. The Committee recommended the Council to agree to the following arrangements:—That the application of the company be granted on condition that the whole of the centre poles on the several routes in Gateshead be removed by, and at the sole cost of, the company within two years of the date of the declaration. If at any time any of the new poles are found to be in the line of a new street, the position of the pole to be altered at the cost of the company. Each pole to be fixed and fitted with a base similar to those on the west side of Durham Road, to the satisfaction of the surveyor. The Committee also recommended that the application of the company for permission to carry a double set of rails along Sunderland Road, in accordance with plans submitted, be granted on condition that the company pays £180 towards the cost of widening the road. The recommendations were adopted.

Glasgow.—RECORD RECEIPTS.—The tramway receipts for the week ended Saturday, January 8th, are the highest so far recorded in the history of the tramway service. The total receipts from passengers amounted to £24,236—£1,100 better than the previous best, and over £3,000 more than in the corresponding week a year ago. The major portion of the revenue came from the ½d. and 1d. fares.

London.—Considerable delay was caused on the Bakerloo tube railway, on Wednesday, by an outbreak of fire on a train between Oxford Circus and Regent's Park Station.

Manchester.—FEMALE LABOUR.—About 200 women conductors are now employed on the tramway system, and many tributes have been paid to the courtesy and efficiency with which they do their work. It is expected that even larger use of the services of women as guards will have to be made in the near future.

Newcastle-on-Tyne.—INCREASED SERVICES.—The tramway service in the city and the suburbs, which some weeks ago closed down at 9 o'clock at night, is gradually being extended, especially on the more distant routes, as more female workers are being started, and as further volunteer workers are being obtained.

Reading.—FEMALE LABOUR.—The T.C. has engaged 26 women for the tramways, 22 as conductors, two as inspectors, and two as clerks. The first named are paid the same wages as men, viz. 5d. per hour; the inspectors, 30s. per week; and the clerks, 25s. per week.

Rotherham.—The T.C. has been recommended to agree to the Sheffield Tramways Committee's proposal to refer all matters in dispute in connection with the running of additional cars for munition workers to an independent arbitrator, subject to certain protective conditions.

Rochester.—Traffic Difficulties.—The City Council has received a petition protesting against the stoppage of the tramway service on Strood Hill, and in this connection a letter was received from the general manager of the Chatham and District Light Railways Co., which pointed out the difficulties of maintaining the service owing to over 60 per cent. of the employés joining the Colours. Partial service, however, could be given, but only by curtailing the service at Frindsbury Hill. As the result of a subsequent conference, however, the general feeling was that the Frindsbury Hill service was by far the more important, and in the result the company intimated that an effort would be made to provide a modified morning service at Strood. To maintain an afternoon or evening service was practically impossible.

Sheffield.—In view of the services rendered to the State by the Pure and Applied Science Departments of the Sheffield University, and the depletion of the income from students' fees, the City Council has been recommended to make special grants totalling £5,000 out of the revenue of the tramway undertaking.

TELEGRAPH and TELEPHONE NOTES.

New Wireless Receiver.—According to the *Madrid Cientifice*, trials have been made at Corunna of a radiotelegraphic receiver, invented by Prof. Gonzalo Brano, with excellent results. The increase in sound has allowed of the hearing of messages from Madrid and all the stations on the Spanish military system, including those in Africa. It has also been found possible to receive by ear, with the telephone, messages from the Eiffel Tower, Poldhu, and Norddeich, and to record on the Morse tape messages from all the stations mentioned.

Wireless Communication Across the Pacific.—Communication has been established between the United States and Japan by way of the Marconi wireless stations at San Francisco and Honolulu, in conjunction with the new Japanese Government station at Funabashi, near Tokio. The distance between terminals is 3,400 miles. Commercial service will shortly be commenced.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—January 19th. P.M.G. Carbon and manganese powder, manganese chloride, chloride of ammonia, porous pots, outer jars and carbon blocks. See "Official Notices" January 7th.

February 18th. Melbourne, Brunswick and Coburg Tramways Trust. Six radial trucks.*

Brisbane.—January 23rd. P.M.G. Wheatstone apparatus. See "Official Notices" Dec. 17th.

April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" December 31st.

Melbourne.—February 16th: 51 electric staff instruments. February 23rd: Two commutator slotting machines, for the Victorian Railway Commissioners.*

February 2nd. Agent-General for Victoria. Fuse distribution boxes and fuses, for the Victorian State Railways. See "Official Notices" to-day.

Sydney.—January 31st. Three electrically-operated railway freight-car transferers for Jones Bay wharfage, Pyrmont. Particulars from Engineer-in-Chief of the Harbour Trust, Circular Quay.

January 20th. Silk-covered wire, for P.M.G.*

February 7th. Metropolitan Board of Water Supply and Sewerage. For No. 1 pumping station at Ultimo. Two centrifugal pumps and electric motors (4,000 gallons per minute each), switchboards, starters, &c. Contract No. 1,301.*

February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.

Birkenhead.—January 17th. Corporation Electricity Department. Washed and unwashed rough slack coal for the period ending June 30th, 1916. Mr. G. P. Shallcross, Electrical Engineer, Craven Street.

Croydon.—January 24th. Corporation. Stores for the Tramways Department. Particulars from the Manager, Tramways Department, Thornton Heath.

Dublin.—January 21st. Corporation. Arc lamp carbons. See "Official Notices" to-day.

London.—Islington.—January 21st. B.C. Twelve months' supply of engine-room stores, electrical fittings, meters, cables, &c. See "Official Notices" Dec. 31st.

Battersea.—The B.C. is recommended to invite tenders for the supply of oils, engine-room stores, electricity meters, service joint-boxes, troughing, ironmongery, &c., and coal, for the electricity undertaking, for alternative periods of three, six, nine and twelve months from March 31st next.

H.M. Office of Works.—January 17th. White earthenware electric lamp shades. Forms of tender from Controller of Supplies, H.M. Office of Works, 18, Queen Anne's Gate, S.W.

Manchester.—January 18th. Corporation. Sub-station converters, traction boosters, high and low-pressure steam piping, for the Electricity Committee. Specification from Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

New Zealand.—Auckland.—February 23rd. City Council. Centrifugal pumping electric motors, and automatic starting and controlling apparatus, for the four city pumping stations. Specifications from the office of the Water Board, Town Hall, Auckland.

Dunedin.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.

Raetihi.—March 14th. Town Board. 40-h.p. hydro-electric generating set, switchboard, &c. Plans and particulars from Messrs. H. W. Climie & Son, Raetihi.*

Wellington.—March 8th. Public Works Office. One 3,000 kw. generator and one 4,300-h.p. water turbine, at Lyttelton, for the Lake Coleridge electric power scheme. Specifications, &c., may be consulted by British firms at the office of the High Commissioner in London for New Zealand, at 13, Victoria Street, S.W.

Pembroke (Dublin).—February 7th. U.D.C. Twelve months' supply of electrical goods. Specifications from the Town Hall, Ball's Bridge, Co. Dublin.

South Africa.—January 17th. S.A. Railways Administration, Johannesburg. 74,966 drawn-wire tungsten lamps.*

Spain.—Tenders have just been invited by the municipal authorities of San Ildefonso (Province of Segovia) for the concession for the electric lighting of the town during an indefinite period.

Todmorden.—January 24th. Electricity Department. 1,000 tons of steam slack or nuts (40 tons per week). Tenders to Mr. H. Garratt, Town Clerk, Municipal Offices.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The Broken Hill Associated Smelters Pty., Ltd., has accepted the tender of Messrs. Fraser & Chalmers for two 2,000-kw. turbo-alternators.

Bradford.—The Electricity Committee has given instructions for a spare rotor for the 3,000 kw. turbo-generators at the electricity works to be obtained from the British Thomson-Houston Co.

Bristol.—The Docks Committee of the T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for a motor starter for a two-ton electric capstan at the Royal Edward Dock.

Bury.—The tender of Messrs. Jas. Byrom, Ltd., has been accepted for the extension of the boiler house at Chamber Hall generating station.

Chesterfield.—The T.C. has been recommended to accept the tender of the British Thomson-Houston Co., at £1,180, for the supply of a 6,600-volt, 30-period, 600-h.p. induction motor installation, subject to a loan being sanctioned.

London.—The Metropolitan Water Board has accepted the tender of Messrs. F. Smith & Co. for copper cable for coal-unloading plant, the value of the contract being £175.

The Metropolitan Asylums Board has accepted the tender of Messrs. J. W. Gray & Son, at £25, for repairing defects in the internal telephone system at Queen Mary's Hospital.

Luton.—The Jackson Electric Stove Co., Ltd., has obtained the order from Messrs. Dudeney & Johnson for a complete cooking equipment for their restaurant in Luton. The installation is designed to cope with the requirements of 250 people.

The Electricity Committee recommends the acceptance of the tender of Messrs. Aiton & Co., at £758, for the supply of pipework for the additional cooler. Six tenders were received.

Nuneaton.—The T.C. has accepted the following tenders:—

Feeder panel.—British Thomson-Houston Co., Ltd., £71.
Overhead electric line.—B. I. & Helsby Cables, Ltd., £437.

Southampton.—The T.C. has accepted the tender of Messrs. Driver & Co., at £588, for the supply of 60,000 deal blocks for the Tramways Department.

Sunderland.—The T.C. on Wednesday accepted the following tenders:—

Ferranti, Ltd.—Meters.
Underfeed Stoker Co., Ltd.—Two Underfeed stokers.
R. Hudson & Sons.—Work in connection with installation of stokers.

Stockport.—The Tramways Committee has accepted the following tenders :—

Steelbanding wire.—British Westinghouse Co.
Field coils for motors.—Dick, Kerr & Co., Ltd.
Bell pushes, P. & B. Tape.—L. Andrew & Co.
Castings.—Malleable Steel Castings Co.

The Electricity Committee has accepted the tender of the Yorkshire Commercial Motor Co. for a steam wagon, fitted with mechanically operated tipping end body, rubber tires, and three-speed gear, £695.

Wigan.—The E.L. Committee has purchased 16,000 tons of coal from the Bryn Hall Colliery Co., Ltd., at 14s. 6d. per ton, compared with 11s. 6d. paid last March.

FORTHCOMING EVENTS.

Association of Supervising Electricians.—Tuesday, January 17th. At 8 p.m. At St. Bride's Institute, Bride Lane, E.C. Half-yearly meeting and informal discussions.

Nottingham Society of Engineers.—Wednesday, January 19th. At 7.30 p.m. At the Welbeck Hotel, Milton Street. Paper on "The Use of Electricity in the Conveyance of Coal from the Working Face to the Pit Head," by Mr. R. A. Sheldon.

Institution of Electrical Engineers.—Thursday, January 20th. At 8 p.m. At Victoria Embankment, W.C. Paper on "The Principles of Modern Printing Telegraphy," by Mr. H. H. Harrison.

Chemical Society.—Thursday, January 20th. At 8.30 p.m. At Burlington House, Piccadilly. Ordinary meeting.

Royal Institution of Great Britain.—Thursday, January 20th. At 3 p.m. At Albemarle Street. Lecture on "The Utilisation of Energy from Coal: The Chemistry and Economics of Coal and its By-products," by Prof. W. A. Bone, F.R.S.
Friday, January 21st. At 5.30 p.m. Lecture on "Problems in Capillarity," by Prof. Sir J. Dewar, F.R.S.

Greenock Electrical Society.—Friday, January 21st. At 7.45 p.m. At the Temperance Institute, 12, West Stewart Street. Paper on "Direct-current Machines," by Mr. J. A. Kinnaird.

Institute of Mechanical Engineers.—Friday, January 21st. At 8 p.m. At St. George Street, S.W. General meeting.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, January 22nd. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Electrical Shaft Winding," by Prof. D. Burns.

Manchester Association of Engineers.—Saturday, January 22nd. At the Grand Hotel, Aytoun Street. Paper on "Cast Iron: The Strength and Properties of Castings," by Mr. E. L. Rhead.

NOTES.

Information Invited.—Will any of our readers who have lately had unfortunate dealings with a firm supplying refills for electric pocket lamps kindly place themselves in communication with the Editors of the ELECTRICAL REVIEW, sending particulars? The strictest confidence will be preserved.

Foreign Trade.—FIGURES FOR DECEMBER AND FOR THE YEAR.—The following are the electrical and machinery figures given in the official returns for December :—

	Month of December.		*Inc. or dec.*	*Twelve months, 1915.*		*Inc. or dec.*
IMPORTS.	£		£	£		£
Electrical goods and apparatus, excluding machinery and uninsulated wire	112,003	+	22,087	1,096,234	−	146,536
Machinery ...	700,808	+	156,572	8,847,844	+	2,135,345
EXPORTS.						
Electrical goods and apparatus, excluding machinery and uninsulated wire	258,792	+	74,429	3,180,809	+	162,209
Machinery ...	1,474,256	+	17,975	19,192,153	−	12,170,940

Fatalities.—An inquest was held on Monday into the cause of death of James Hughes. The evidence of a taxi-driver was to the effect that he was on his stand in Piccadilly on the previous Friday when he saw two men on an extended telescopic ladder tower. They were repairing electric arc lamps. He noticed that while they were at the foot cleaning a globe the ladder wagon was blown by the wind for some 20 yards on its wheels. The men fetched it back, and, having placed it in position, went to the top to fix the globe. Suddenly the ladder was blown over. Hughes was removed to the infirmary, but was dead on arrival. The other man (Herbert Ball) was badly injured. Alfred Wilkinson, a superintendent of the department, said he did not think the accident would have happened if the jack had been used and the ladder had been set on its feet instead of being left on the wheels. He thought there had been an error of judgment. A verdict of "Accidental death" was returned.

ROCHDALE.—Last Wednesday an inquest was held on Richard Richards (52), labourer, of 4, Slack Street, Rochdale, who was found terribly injured in the motor room at Messrs. Kelsall and Kemp's mill. It appeared that deceased was working on some repairs in the dynamo room, and was asked by a colleague to take a wire template from the dynamo room to the workshop in Penn Street. Shortly afterwards the assistant engineer at the mill heard the motor in the adjoining room start running, and immediately afterwards there was a shout for help. He went into the adjoining room, stopped the motor, and found deceased lying on his back with his head against the driving pulley and the wall. He suffered from a compound fracture of the base of the skull, and a crushed right arm, and died later from shock and hemorrhage. Mr. J. H. Chadwick, deputy coroner, said there was no satisfactory explanation as to how the accident happened, although it was suggested that the man was taking a short cut. He had no business to be where he was found, and had he gone the other way round, the accident would never have happened. "Death through misadventure," was the verdict.

WOLVERHAMPTON.—An inquest was held on Friday, last week, at Wolverhampton, concerning the death of Richard Thomas Akers (19), who was killed at the works of the Efandem Electrical Co. on 5th inst. Mr. Clarkson and Mr. A. C. Skidmore represented the Efandem Co., Mr. Randle J. Evans appeared for the relatives of the deceased, and Mr. A. Wolfe, H.M. Inspector of Factories, was also present.

Ethel Rose Williams, a girl employed by the Efandem Co., deposed to a conversation which she had with Akers prior to his death. She said he had called her attention to a wire over a door which was hanging down, and remarked that if he did not put it right some one might have a shock. It was shortly afterwards that the sister of Akers reported that he was on the floor looking funny. Witness had not seen the wire before Akers called her attention to it. Replying to Mr. Evans, witness said she should think the wire was hanging low enough to touch Aker's head when he went through the door.

John Molloy, a youth said he saw the wire hanging a quarter of an hour before the accident. To witness's knowledge it had been in the same position for about three days, and it was about a yard and a half from the ground.

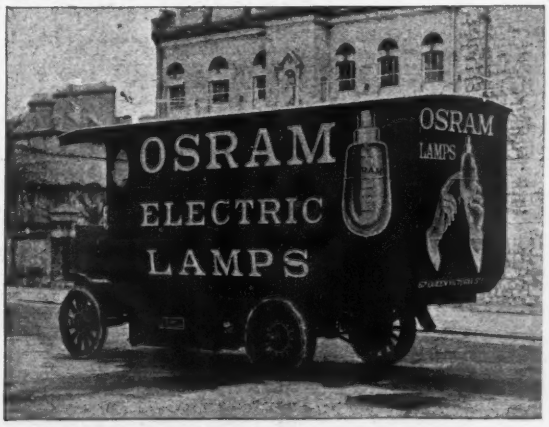
Frederick Thomas Ridgeway, electrician at the works, said the gale during the holidays blew a shed down, and when work was resumed on the Tuesday after Christmas he had all the fuses withdrawn, and the plant on that particular circuit rendered safe. For the wire in question to be "alive" the fuses must have been put back; but who had done this witness did not know. He had no idea that the wire had been hanging until his attention was called to it. It had been looked at. Two or three men had spoken to him about light, and he had told them they could not have any; he suggested that they should use torches. Witness subsequently discovered that the fuses had been replaced by some one.

After hearing medical evidence, the jury went to inspect the wire, and on their return the foreman said they would like to know who replaced the fuses.

The Coroner said that was a thing they would never know. Whoever did it exceeded his duty, and the one who took upon himself to do it caused the death of this unfortunate youth.

The jury found that "Death was due to electrocution, as the result of an accident."

An "Osram" Electric Vehicle.—We illustrate herewith an Osram electric vehicle which has lately been added to the fleet of express delivery motors employed by the G.E.C. for the delivery of Osram lamps to all parts of the United Kingdom. This van is handsomely finished in dark blue; the gross weight is 2 tons 12 cwt., of which the Edison accumulator accounts for



16 cwt. A load of 2 tons can be carried, the accommodation being sufficient for between 11,000 and 12,000 standard Osram lamps The average speed on the flat is 10 M.P.H., and between 40 and 45 miles can be covered on one charge. Re-charging is effected by a dynamo at the Osram-Robertson Lamp Works in Hammersmith. In addition to rheostatic braking, a system of hand brakes is provided.

Patents and Alien Enemies.—As the result of an application lodged by Messrs. Ferranti, Ltd., licences granted to the Allgemeine Elektricitäts Gesellschaft in respect of Patents Nos. 21,037/03, 26,359/12, and 12,926/14, granted to Hamilton, have been avoided.

Institution and Lecture Notes.—Institution of Civil Engineers.—On Tuesday last a paper on "The Electric Locomotive" was read by Mr. F. W. Carter, in which the author reviewed the various classes of locomotive that have been evolved, and discussed the comparative merits of the methods employed for transmitting the torque from the motors to the driving axles. The question of stability of the rolling motion of the wheels was considered in connection with the tilting of the rails and the coning of the wheels, and it was shown by novel methods of analytical treatment that, under certain conditions, a "nosing" tendency at high speeds might be anticipated, a remedy being found in the use of guiding wheels elastically centred to align with the main driving wheels. Recent data of tractive-resistance tests on the New York Central and Hudson River Railroad were given, showing conclusively that, for a particular type of coach, the additional tractive resistance per additional coach was a function of the speed, and was independent of the number of coaches, provided this was greater than two, and was a straight-line function of the speed within the limits of the tests. In the discussion which followed, Messrs. Merz, Thornton, Aspinall and Roger Smith took part, and the discussion was adjourned to January 25th.

Greenock Electrical Society.—On Friday last a paper was read by Mr. W. B. Smith on "The Economy of Electricity in a Small Household." It was shown that by the general use of electric heating appliances the consumer would ultimately benefit by the consequent general reduction of electricity charges, just as the lighting consumer had already benefited through the cultivation of a power load for central stations. The advantages and costs of electric cooking were fully explained, and figures were advanced from actual results obtained in houses in Greenock.

Institution of Electrical Engineers.—At a meeting of the SCOTTISH LOCAL SECTION held in Glasgow on Tuesday last, Mr. J. R. Beard's paper on "The Design of High-Pressure Distribution Systems" was read and discussed.

A meeting of the MANCHESTER LOCAL SECTION was held on Tuesday last, when a paper was read by Prof. Miles Walker on "The Predetermination of the Performance of Dynamo-Electric Machinery," and a discussion followed.

At a meeting of the NEWCASTLE-ON-TYNE LOCAL SECTION, on Monday last, Mr. J. R. Beard read his paper on "The Design of High-Pressure Distribution Systems," and a discussion followed.

At the meeting of the YORKSHIRE LOCAL SECTION on Wednesday last Mr. Beard's paper was read and discussed.

Educational.—UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.—A course of six lectures on the "Electrical Production of Nitrates for Fertilisers and Explosives" will be delivered by Mr. E. Kilburn Scott, M.I.E.E., A.M.Inst.C.E., on Wednesdays at 5.30 p.m., beginning on January 26th, 1916. The first lecture is open to the public without fee, on application to the Secretary, University College, Gower Street, W.C. The course is open both to members and non-members of the University, the fee being £1 11s. 6d.

Volunteer Notes.—ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEER CORPS.—Headquarters, Chester House, Eccleston Place, S.W.—Orders for week commencing January 17th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Saturday, January 15th.—Uniform Parade, 2.45 p.m., Chester House.

Monday, January 17th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad, Signalling Section and Recruits.

Tuesday, January 18th.—School of Arms, 6 to 7 p.m.

Thursday, January 20th.—Shooting for Sections 3 and 4.

Friday, January 21st.—Sections 3 and 4, Technical; Sections 1 and 2, Squad, Signalling Section and Recruits.

Sections for Technical Parade at Headquarters, London Electrical Engineers, 46, Regency Street, S.W.

Sections for Shooting Parade at Miniature Ranges.

Unless otherwise ordered, all Parades at Chester House.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON REGIMENT (VOLUNTEERS).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, January 13th, 1916:—

Week-end Parades.—Saturday.—The Battalion will parade at Baker Street Station at 2.30 p.m. and proceed by train to Dollis Hill, where they will detrain, proceeding by march route to Wembley Park.

Sunday.—The Battalion will parade at 9.30 a.m. at Liverpool Street Station (low-level entrance) and proceed by train for entrenching duties, arriving in town, on the return, about 6 p.m. Members will make their own arrangements for lunch.

Musketry.—The Acton Range will be open on Saturday, the 15th inst., both morning and afternoon, for Inter-Platoon Competition practice. Shooting to commence at 11 a.m. and 2 p.m. Members when sending in their names should advise the Musketry Staff at what time they will attend, to enable necessary arrangements to be made. Members must parade in Uniform. Names must be sent into Headquarters not later than Friday midday.

As the days are short, it is hoped members will help the Musketry Staff by attending punctually.

A. G. JOINER, *Major and Adjutant*, O.B.C.

Social.—On the last day of the old year, Messrs. Crypselco, Ltd., of Bedford, entertained their employés. The works closed early, and at 6 o'clock the staff and the employés, numbering some 300, sat down to high tea. Mr. H. S. Deacon extended a welcome to all, after which the party moved to the entertainment hall, where a programme was carried out by London artistes, Mr. Reg. Wishart's mystery box trick being especially appreciated. At 9 o'clock the company adjourned for dancing, recreation and refreshment. On the stroke of midnight, hands were joined in one immense circle, and "Auld Lang Syne" was sung with feeling and enthusiasm, which brought the evening to an end. All the arrangements were carried out by the staff, under the direction of Mr. A. R. Powell and Mr. A. R. Harrisson.

French Prizes.—The French Academy of Sciences has awarded the Hébert prize for physics to Prof. Pupin for his important services to telegraphy and telephony and his method of harmonic analysis; the Hughes prize to M. R. Marcelin, a young scientist of the first rank, who was killed in September, 1914; and the Gaston Planté prize to M. Marcel Moulin, for his researches in radiation, who was killed in September, 1914. Out of 37 awards, no fewer than 11 were to men who had fallen in battle.

Manchester Engineers' Demand Refused.—The Committee on Production announced on Monday that it had decided to refuse the application of engineers in the Manchester district for an advance of 6s. a week on time and 15 per cent. on piece rates. The Committee declares that no substantial case for an increase has been made out. Some 30,000 skilled engineers and about the same number of semi-skilled and unskilled workers are affected by the decision. Early last year the men received an advance of 3s. a week and 10 per cent. on piece rates.—*Manchester Courier.*

Appointments Vacant.—Shift engineer and three attendants, for Military Camp in North Yorkshire; shift engineer (£2), for Queen Mary's Military Hospital, Whalley; shift engineer, for the Walsall Corporation electricity department; charge engineer (£3), and junior engineer (£2), for the Southwark B.C. electricity department; station assistant and shift engineers, junior engineers and attendants, foreman of works, pumping engineers, station fitters, engine drivers, stokers, trimmers, linemen, wiremen, mates and labourers, for the Military H.T. electric power installations in the Northern Command. See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—Mr. H. F. RICHENS, late assistant distribution engineer at the Stockton-on-Tees Corporation electricity works, has taken up an appointment with Messrs. Naylor Bros. (London), Ltd., Southall, Middlesex.

The Wimbledon B.C. has increased the salary of Mr. H. OSWALD, one of the engineers in charge at the electricity works, from £104 to £130 per annum as from January 12th, 1916.

Mr. ERNEST A. HILTON, who is employed in the Manchester Corporation electricity department, was married at Marple last week to Miss Ellen Kay, of Bleak House, Ludworth. Among the presents were a silver cake basket and a biscuit barrel from the bridegroom's colleagues in the above department.

St. Helens T.C. has increased the salary of Mr. H. C. DUNCAN, commercial assistant at the electricity works, to £150 per annum, and that of Mr. B. T. HAWKINS, electricity station superintendent, to £200.

Peterborough T.C. has applied to the War Badge Department of the Ministry of Munitions for war badges for the following members of the electricity works staff, whose services are considered indispensable for the proper operation of the generating station:—Mr. T. ROWLAND, chief engineer; Mr. R. ROWLAND, mains superintendent; and Messrs. W. MILLINGTON, J. PRESCOTT, and S. POOLE, shift engineers.

Mr. C. W. SHEPHERD has resigned the position of general manager of the Edinburgh and District Tramway Co. The board have accepted the resignation, and asked him to continue his services as secretary. Mr. J. D. R. COX, of Messrs. Babcock & Wilcox, has been appointed general manager and engineer to the company. Mr. Shepherd has been in indifferent health for some time. He has been associated with tramway work for 32 years.

Reading T.C. has refused the general manager and engineer of the tramways leave of absence for immediate military service, but has raised no objection to his presenting himself for attestation in Section B of the Army Reserve.

At the Leeds City Council last week considerable discussion took place with reference to the recommendation of the Electricity Committee that the salary of Mr. C. N. HEFFORD, manager of the electricity department, should be increased from £600 to £800 per annum. Mr. Hugh Lupton pointed out that Mr. Hefford was appointed on probation three years ago on the understanding that if he did his work well he would receive a salary commensurate with the duties of his office. Mr. Hefford's predecessor received £900, and had afterwards received £1,000 at Liverpool, and this had later been increased to £1,500. An amendment was moved that the increase should not take place until the termination of the war, but this was defeated by 32 votes to 19, and the original recommendation was carried.

Mr. Hampton E. Blackiston, district mains and sub-station engineer, South Wales Electrical Power Distribution Co. (formerly of the Cleveland & Durham Electric Light & Power Co., Nuneaton Corporation, etc.), was recently married to Olive Isabel, eldest daughter of Mr. and Mrs. A. J. Siedle, of Streatham.

General.—Mr. Edward Vickers, for 14 years chief electrical engineer to Messrs. Walter Locke & Co., Ltd., of Calcutta, has returned to this country, and now represents Messrs. Luke, Stonebridge & Co., Ltd., electrical engineers and contractors, of Calcutta and Lahore. Manufacturers of electrical apparatus are invited to address him at Pinley Green, Warwick.

Mr. J. G. Menker, late chief electrician at South Crotty Mines, Poole (Cornwall), who some time ago joined the Royal Flying Corps, has been promoted to the rank of first-class air-mechanic. He is at present at Farnborough.

It is announced that Professor W. H. Perkin, F.R.S. (son of the late Sir Wm. Perkin), Professor of Chemistry at the University of Oxford, has accepted the post of head of the Research Department of British Dyes, Ltd., and the chairmanship of the advisory council of that company.

Mr. P. J. Pybus, M.I.E.E., has been appointed by the Bradford Education Committee as external examiner in electrical engineering for the final examinations for the Technical College Diplomas and for the Technological Exhibitions, and Prof. W. H. Watkinson, M.I.E.E., and Mr. James Watson, M.Inst.C.E., have been appointed external examiners in mechanical and civil engineering respectively.

In the ballot list for the next meeting of the Institution of Mechanical Engineers, the Rt. Hon. Lord Montagu of Beaulieu is nominated for election as an Associate. His Lordship's marvellous escape from drowning after the Hunnish attack on the *Persia* has spared for the roll of this engineering institution the name of one whose services have been as brilliant as the title that he bears is exalted.

Roll of Honour.—Regt. Sergt.-Major James Gill, of the 23rd Battalion Rifle Brigade, who has been presented by the N.C.O.'s with a sword, held a position in the traffic department of the Blackpool Corporation tramways system prior to rejoining the Army.

Trooper Leonard C. Butterworth, of Chadderton, aged 20, who has been killed in France, was an electrical meter tester in the employ of Messrs. Ferranti prior to the war.

Private Jas. L. Horne, of the 1/6th Battalion Manchester Regiment, who was, prior to the war, engaged as an electrical engineer at Manchester, is reported killed in action, after being missing at the Dardanelles for some months.

Lieutenant H. C. Jones, of the 3rd (Toronto) Battalion, 1st Canadian Division, who has died in hospital in London from wounds received in action, was formerly with Messrs. Stothert and Pitt, engineers, of Bath.

Private Samuel Hamer, of Monton, who has been on active service with the 16th Lancashire Fusiliers, is reported killed in action. He was 26 years of age, and, prior to the war, was employed at the British Westinghouse works at Trafford Park.

Corporal C. M. Dean, of the 7th South Lancashire Regiment, formerly employed at the British Westinghouse Works, Trafford Park and at the Peel-Conner Telephone Works, Salford, has died from wounds received in action.

Lieutenant Norman Coutie Lowson, Royal Engineers, Special Reserve, 7th Division, a son of Mr. James Lowson, senior partner of Messrs. W. C. Martin & Co., electrical engineers, Glasgow, has been twice mentioned in dispatches during the past six months, first for distinguished service in the field at the battle of Neuve Chapelle, and now more particularly in relation to the fight at Loos.

Obituary.—Mr. Richard Grigg.—We deeply regret to learn of the sudden death at Ottawa of Mr. Richard Grigg, Commissioner of Commerce in the Canadian Trades and Commerce Department, with whose reports on Canadian trade, prepared several years ago, our readers are familiar. Mr. Grigg was a native of Plymouth, and in 1907 was chosen to be head of the British Intelligence Service in Canada.

Mr. A. Ilg.—The *Times* states that Mr. Alfred Ilg, the engineer and confidential counsellor of the Emperor Menelik, has died at Zurich at the age of 62. He went to Abyssinia in 1878 to superintend the construction of roads, bridges, fortifications, telegraphs, etc.

Mr. John Cameron Swan.—The death has just occurred of Mr. John Cameron Swan, elder brother of the late Sir J. Wilson Swan. Mr. Swan was 89 years of age, and he is described as a prominent figure in Newcastle business and scientific circles for half a century. He was well known in the chemical trade as a manufacturer and merchant, and he had also been closely identified with manganese and other mining operations.

Will.—The late Prof. R. Meldola, F.R.S., left £33,767 net personalty.

CITY NOTES.

Anglo-American Telegraph Co., Ltd.—The following dividends are announced to the close of the year, 1915, viz.:—A balance dividend of £1 10s. per cent. upon the ordinary consolidated stock for the year, less income-tax at 2s. 11d. in the £; a balance dividend of £1 10s. per cent. upon the preference stock for the year, less income-tax at 3s. 2d. in the £; a first and final dividend of £1 10s. per cent. upon the deferred stock for the year, less income-tax at 2s. 8d. in the £. These dividends are payable on February 1st, and, together with those already paid, they will amount to £3 15s. per cent. on the ordinary consolidated stock, £6 per cent. on the preferred stock, and £1 10s. per cent. on the deferred stock for the year 1915. A bonus of 1s. 9d. per cent. is to be paid on the undivided ordinary stock, and one of 3s. 6d. per cent. on the deferred stock, free of income-tax.

Buenos Aires Lacroze Tramways Co., Ltd.—The report for the year ended June 30th states that, notwithstanding the higher value of coal, the cost of which has risen 40 per cent., the percentage of working expenses has been lower owing to economy practised. The gross receipts amounted to $6,100,652 m/n, a decrease of $321,820. The working expenses were $3,760,781 m/n, a decrease of $222,882 m/n, leaving as net profits on working $2,339,871 m/n.—*Financial Times.*

Dublin United Tramways (1896) Co., Ltd.—The directors have declared a dividend at the rate of 5 per cent. per annum on the ordinary shares for the past half-year. £5,000 has been placed to reserve and renewal fund, £18,000 allocated for renewal of rails, and £13,045 carried forward.

Direct United States Cable Co., Ltd.—An interim dividend of 2s. per share, less income-tax at 8s. 2d. in the £ (at the rate of 4 per cent. per annum), is announced for the quarter ending December 31st, 1915.

Greenwood and Batley, Ltd.—The directors report a profit balance of £47,226 to July, 1915, plus balance at credit at March 31st, 1915, £6,417, making £53,644. After placing sums to depreciation and reserve and paying the 7 per cent. cum. pref. dividend, a dividend is to be paid of 25s. per share on the fully-paid ordinary shares and of 12s. 6d. per share on the £5 paid ordinary shares, absorbing £23,738, leaving £7,906 to be carried forward.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets are a little undecided. What rather unsettled the investment department was the issue, towards the end of last week, of French Treasury Bills of twelve months' currency, bearing interest of 5% per cent., and so affording a yield of 6 per cent. on the money. This came as a further reminder of the urgency of the money question, and our own War Loan wavered, causing other sound stocks to lose some of their recent steadiness.

Taking 6 per cent. as the newly-established credit of the French Government, it will be noticed that a number of debenture stocks, and even preference shares, in our electrical price lists give a return of less than this on the money. Time was when French credit stood highest in the world, next to that of British Consols, but, judged by temporary quotations—and, after all, the comparison is on empirical grounds only—there are British industrials whose attractions in the eyes of the investor are greater than the bonds of our nearest ally.

The Home Railway market is rousing a little interest, though of the lethargic order, in the forthcoming dividends, amongst the first of which will be that of the Metropolitan Railway, the announcement being due on January 27th. In the market, it is thought that the company will pay about the same as it did this time last year—namely, 1 per cent., which would make 1 per cent. for the year, and afford a return of about 4 per cent. on the money. It is not supposed, of course, that the deferred dividend stock will come in for any distribution this time. The Surplus Lands will no doubt get their 2¾ per cent., and the yield on this stock comes to 5½ per cent. on the money at the present price of 50.

An unkindly joke in the market is to the effect that District ordinary stock will get the same dividend as usual. Incidentally, it may be recalled that the last time that this stock received anything at all was in August, 1882. There is still a little business being done in East London ordinary, on the basis of 3½. Underground Electrics have been active, and the income bonds shot up another 2¼ to 81¼. For the £10 shares £2 was bid the other day, but the price tempted sellers and the shares have gone back a little to 38s. 9d.; while the "A" 1s. shares, after touching 6s. 9d., are 6d. up on the week at 6s. 6d. London and Suburban Tractions have been wanted at cheap prices, but did not come to market. There is nothing doing in London United Tramways 4 per cent. debenture stock, of which, however, there are buyers at 51 or thereabouts.

Anglo-American Telegraph deferred stock rose ¾ on the declaration of the usual dividends, with an extra 1s. 9d. on the ordinary, giving 3s. 6d. to the deferred. This came as an unexpected surprise, while it underlines the suggestion made here on several occasions, namely, that the deferred stock is quite a good speculative investment of its class. The 6 per cent. preferred at par is also recommendable, from the point of view of security, but there is not much to go for in the way of probable appreciation in the price.

The Treasury is bidding 100¼ for New York Telephone 4½ per cent. bonds, this price applying to the sterling issue. The

first price posted in the Stock Exchange was 103¼, and there was a rush round to the Government Office to sell at this figure. The holders elaborately explained—afterwards—that they were neither surprised nor chagrined to find that the price of 103¼ referred to dollar bonds only, and that 3 points had to be allowed in respect of the sterling issue. The Government bid was distinctly higher than that of the market, because the bonds were on offer at 100 last Thursday, while the Government offered 100½ on the following morning.

The Telegraph market as a whole is very steady. There is considerable scarcity of the Eastern descriptions; and while the jobbers are ready enough to quote prices, they smile rather pityingly when a broker comes to ask them to make a price in some of the various stocks with which they are not supplied. "We can buy of you," they say; "but we have none to sell." Marconis are strong on the anticipation that the company is about to issue a statement showing what payments the Government will make to the company for the use of its system since the outbreak of war.

Brazilian Traction shares are a dull spot in consequence of a relapse in the Rio exchange to under 1s. This question of exchange is worrying not a little some of the markets connected with Brazilian stocks, but others profess that it should be disregarded, inasmuch as the fluctuations are so frequently brought about merely by speculators on the other side of the Atlantic. This, of course, is likely enough; but, at the same time, a fall in the exchange does not encourage confidence in the holders of Brazilian securities. Mexican stocks and shares of various kinds are dull and depressed. British Columbia Electric Railway deferred stock is 5 points lower. The Anglo-Argentine Tramways group shows a disposition to droop, noticeable in small declines in the debenture stocks.

Metropolitan Electric ordinary went back ½ to 2½, but otherwise there are no changes in the list of home electricity shares. County of London change hands with a fair degree of frequency on the basis of 10; and in some of the others there are occasional bargains about the figures quoted in our price lists. Speaking generally, however, there is no fresh animation in this department. May we add an expression of great regret at the loss which the market has just sustained in the death of Mr. H. B. Mudie, a well-known member of the House, who, before the war broke out, used to deal in electric lighting shares. Outside the Stock Exchange, he was best known as one of the leading exponents of Esperanto; and the news of his death in France came as a shock to his wide circle of friends.

British Westinghouse preference constitute the outstanding feature in the manufacturing group. The price has spurted 5s. to 2½, and the company is said to be doing exceedingly well with its war contracts. A lively business has sprung up in the shares; while, on the other hand, the recent activity in British Aluminiums has somewhat subsided. Prices of other manufacturing shares keep firm, without attracting a great deal of attention, so greatly has public interest become absorbed at the present time in the market for rubber shares.

And the rubber market remains the most active in the Stock Exchange. The other day the price of the raw stuff reached 4s. 3½d. per lb., and the buoyancy increased until the animation wore the appearance of a boom in miniature. Despite Treasury regulations, there has been a lot of speculation during the past few weeks; and probably there were a good many men in the market not greatly displeased to see the price of the raw material slip back to 4s. per lb., which induced a few sales of shares, enabling the recent sellers to replace their stock at more reasonable figures than those lately prevailing.

In the armament group, it is noticeable how Vickers have just lately overhauled Armstrongs and passed them in price, though the difference between them is still a matter of a few pence only. There is a certain amount of life in copper shares, and the market is a good one for the time being.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	
		£	£		£	£		Inc.
Blackpool-Fleetw'd	Jan. 1	1,233	— 86	52	38,964	— 320	8	..
Bristol	Dec. 31	45,977	+9,756	52	506,928	+5[illegible]22	30·5	..
Cork	„ 30	1,947	+ 128	52	26,025	+ 143	54·25	..
Dublin	„ 24	24,032	+ 594	51	311,437	+11,072	9·89	..
Hastings	„ 31	2,312	+ 112	52	89,729	— 212	19·8	..
Lancashire United	„ 29	6,352	+ 287	52	89,680	+ 5,399	42	..
Llandudno-Col. Bay	„ 31	734	+ 51	4½	817	+ 80	6·5	..
Tyneside	„ 22	1,925	— 133	25	14,925	— 664	11	..
Anglo-Argentine ..	„ 31	318,689	+4,080	52	2,667,738	—131,039	..	..
Auckland	„ 17	21,804	+1,990	42½	125,810	+ 908	25·42	1·06
Calcutta	Jan. 1	17,901	+1,871	..	..	— 1,597	..	..
Kalgoorlie, W.A. ..	Oct.	2,675	..	43	27,791	..	..	..
Madras	..	..	..	..	..	..	..	..
Montevideo ..	Dec.	31,035	+2,700	9	59,712	+ 4,026	..	..
Dublin-Lucan Rly.	Dec. 31	480	— 28	26	8,868	+ 59	7	..

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Jan. 11, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.				
Brompton Ordinary	10	7½	—	£5 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	6	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	8½	—	6 0 0
do. do. City Pref.	4½	8 xd	—	7 10 0
do. 4 Deb.	4	73	—	5 2 7
Chelsea*	5	4½	—	5 17 8
do. 4½ Deb.	4½	87	—	5 8 6
City of London	9	12½	—	7 7 3
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	98 xd	—	5 2 0
do. do. 4½ Deb.	4½	85 xd	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
do. do. 1st Deb.	4½	85 xd	—	5 5 0
do. do. 2nd Deb.	4½	88	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅝	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	2½	2½	— ⅛	7 15 7
do. 4½ per cent. Pref.	4½	2½ xd	—	6 18 6
do. 4½ Deb.	4½	85	—	5 6 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6	—	8 6 8
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 3½ Deb.	3½	70 xd	—	5 0 0
South London	5	2⅝	—	7 5 6
South Metropolitan Pref.	7	1⅛	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
do. 4½ Pref.	4½	4	—	5 12 8
TELEGRAPHS AND TELEPHONES.				
Anglo-Am. Tel. Pref.	6	100	— ¾	6 0 0
do. Def.	33/6	93½	+ ½	7 4 0
Chile Telephone	8	6½	—	6 3 0
Cuba Sub. Ord.	5	8	—	6 5 0
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	12½	—	*6 8 0
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	128	—	*6 4 0
do. 3½ Pref.	3½	66	—	5 6 0
do. 4 Deb.	4	81	—	4 19 0
Globe Tel. and T. Ord.	6	10⅜	—	*6 12 2
do. Pref.	6	10½	—	5 17 1
Gt. Northern Tel.	22	88	— ½	6 13 4
Indo-European	18	48 xd	—	6 15 4
Marconi	10	1⅝	+ ⅛	5 6 8
New York Tel. 4½	4½	100	—1	4 9 1
Oriental Telephone Ord.	10	1⅝	—	5 6 8
do. Pref.	6	⅞	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	6	—	*7 12 5
do. Pref.	5	4⅞	—	5 8 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅝	—	*6 7 0
do. 4 Deb.	4	79 xd	—	5 1 0
HOME RAILS.				
Central London, Ord. Assented	4	73½	—	5 10 6
Metropolitan	1⅝	25½	+ ½	4 18 0
do. District	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	1⅛	—	Nil
do. do. "A"	Nil	6/6	+6d.	Nil
do. do. Income	6	81½	+2½	*8 7 3
FOREIGN TRAMS, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	95	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4	—	6 17 6
do. 2nd Pref.	5½	8½	—	8 8 0
do. 4 Deb.	4	71½	—1	5 12 0
do. 4½ Deb.	4½	77	—	5 17 0
do. 5 Deb.	5	80½	— ½	6 4 0
Brazil Tractions	3½	51	— ½	6 17 3
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	85	—	5 5 0
British Columbia Elec. Rly. Pfce.	5	61	—	8 4 0
do. do. Preferred	—	40	—	Nil
do. do. Deferred	—	95	—5	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	40	—	Nil
do. 5 per cent. Bonds	—	49	—	Nil
do. 6 per cent. Bonds	—	48	—	Nil
Mexican Light Common	Nil	29	—	Nil
do. Pref.	Nil	40	—	Nil
do. 1st Bonds	—	47	—	—
MANUFACTURING COMPANIES.				
Babcock & Wilcox	14	2⅞	—	5 15 0
British Aluminium Ord.	5	23/6	—	4 9 0
do. Pref.	6	18/-	—	6 13 4
British Insulated Ord.	15	10½	—	7 2 10
do. Pref.	6	5½	— ¼	5 11 7
British Westinghouse Pref.	7½	45/-	+5/-	6 13 4
do. 4 Deb.	4	69	—	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11½	—	6 13 4
do. 5 Pref.	5	4½	—	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	3	—	6 13 4
Edison & Swan, £8 pd.	Nil	9/-	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60	—	6 13 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	14/-	—	8 11 6
do. do. Pref.	7	19/9	—	7 1 4
Gen. Elec. Pref.	6	9½	—	6 8 1
Henley	20	13½	—	*8 12 6
do. 4½ Pref.	4½	4½	—	5 6 0
do. 4½ Deb.	4½	93	—	4 17 9
India-Rubber	10	8½	—	*13 1 2
Telegraph Con.	20	8½	—	*8 1 0

* Allowance made for dividends being paid free of income-tax.

Deferred Cable Telegrams.—Owing to interruptions of cables and pressure of traffic, the deferred service has been temporarily suspended.

DIRECT-CURRENT MOTOR MAINTENANCE.

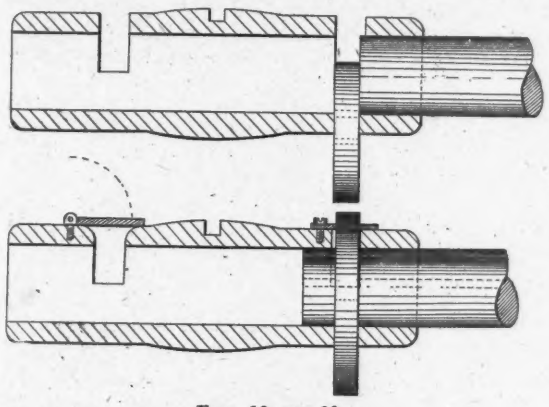
By S. LEES.

(*Concluded from page 7.*)

The writer does not recommend the indiscriminate scouring of commutators, and, speaking from experience, would say that, given average conditions of working, and everything else being equal, the application of the cleaning block should rarely be necessary. If required very fine quality carborundum cloth, or glass paper (cloth, if obtainable), may be used in a wood holder correctly shaped to fit the circumference of the commutator circle. Both of the preceding operations should be followed by a faithful clean-up of the whole machine.

When replacing an armature, after overhaul, say, the mistake is often made of overlooking the presence of the bearing oil-rings, which not infrequently suffer damage before the cause thereof is even suspected. On reference to fig. 18, it is evident that this happens through the ring being in the position shown in the sketch previous to the insertion of the shaft. To obviate such an eventuality a simple rest device, of which two forms are shown at fig. 19, may be fitted with advantage. A prolific source of seized bearings is failure of the oil-ring to travel. This may happen from various causes, chiefly, shortage of oil in the bearing well, the effect of which is to produce "whirling" of the ring, which becomes lodged on the top side of the bush, as shown in fig. 20. The simple expedient of chamfering (correctly) the sides of the ring slot, will effectually prevent the ring from permanently leaving its slot.

Too little attention seems to be given to the proper design of oiling rings. The common flat section type is bad, as it



Figs. 18 and 19.

has a great tendency to stick or become sluggish when working, especially with a heavy-bodied oil. A flat ring of the form represented at fig. 22 almost invariably hugs one side or the other of the ring slot. This is due to the greater capillary effect which is produced at this point than at any other part of the exposed shaft, the cause being the "pull" exerted by the captive film of lubricant already existent between the walls of the bearing shell (edges) and the shaft. The rising ring, coated with oil, is thereby attracted, the result being that the ring hugs or drags along the side of the slot, its rate of travelling being considerably below that which it would otherwise attain were the ring free from the retarding influence above described. Sometimes the ring will stop altogether, and in consequence the bearing heats up, and if allowed to continue thus, seizure follows. With oils which have an oxidising tendency a ring of this type may become stuck so fast as to refuse to move when the machine is started. A well-designed ring should be formed in one truly circular piece without detachable joints of any kind, and possess little inertia beyond that necessary to overcome the tendency to "whip" or whirl. At high rotative speeds a ring which is too light churns or breaks up the surface of the oil and creates "creeping" and throwing along the shaft, and increases loss caused by evaporation, but, what is most serious of all, the errant ring conveys little or no oil to the shaft.

Various forms of chain had formerly some vogue, but the chain has many inherent disadvantages, and nowadays it is seldom used except on slow-moving machinery. To ensure an uninterrupted supply of oil the ring should sweep through a path unobstructed by metal projections, and easily clear the bottom and sides of the bearing oil-well. Two good forms of ring are shown in section at fig. 21. A perforated ring (fig. 23) has greater holding capacity than a plain one, but with the former there is a tendency to "drag," especially with the heavy classes of oils. The writer has often wondered why so many makers still persist in turning out motors having bearings fitted with hinged or flap-doors opening outwards. Such a fitting, especially at the driving side, may easily prove a source of danger

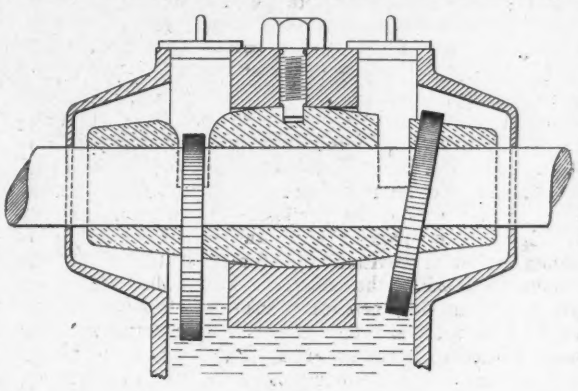


Fig. 20.

with the overhanging pulleys now so commonly used, and in dusty situations dirt accumulates on the lid, and when oiling time comes round, the bulk of the dirty matter oftener than not gets tipped into the bearing well. (This criticism is not meant as an advocacy for the pokey unget-atable order of bearing; by all means have bearings accessible, but at the same time reduce the possibility of entry of injurious matter to a minimum.) Oil openings or inspection apertures covered with large single-hinged lids or doors are bad practice, except, perhaps, for machines working under engine-room conditions. Adequate means should always be provided for thoroughly draining bearing oil-wells, and it is a wise precaution when cleaning out a dirty bearing to give the interior of the well a good flush out with paraffin before refilling with clean oil.

In some designs, the oil from the bearings insinuates itself inside the motor casing owing to the size of hole through which the shaft passes being unnecessarily large. A thick leather ring sandwiched between a couple of felt washers will effectually prevent this trouble, the device being fitted to the inside of the motor casing. Oil-thrower rings should always be so arranged as to come inside the bearing housing.

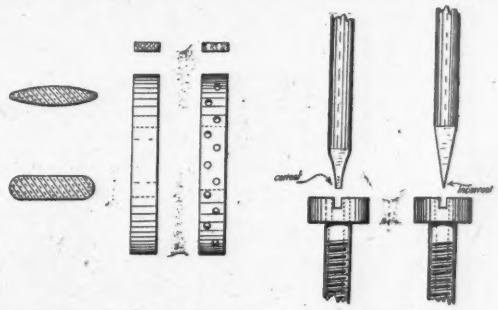


Fig. 21. Fig. 22. Fig. 23. Fig. 24.

Opinions differ considerably as to what is the best and most efficient form of ring, but a plain V section collar slipped on the shaft makes a very satisfactory and reliable device for this purpose; it has, also, the merit of simplicity, which is more than can be said of the many weird contraptions one frequently comes across. The practice of grooving the shaft itself, thread-fashion, is a foolish fetish, and, moreover, it does not prevent oil creeping.

With new machines the importance of clean bearings cannot be over-estimated. It is rarely indeed that intricate

cored castings leave the shop entirely free from traces, at least, of moulding sand or other gritty substances. In addition to pickling and fettling, the usual practice of painting by brush does not always ensure the "fixing" of any sandy matter which may be lurking in, say, some rugged corner or unsuspected blow-hole. A better plan is to pour a sufficient quantity of *suitable* paint in the bearing-well, and after thoroughly swilling around, run off any surplus which may remain. The writer has had his quota of experience of bearing troubles arising directly from the presence of moulding sand. It is fairly well known that, whereas an ordinary ring-fed bearing will often work quite well for long periods even in the presence of gritty matter, a ball-bearing would be ruined probably very quickly; hence the advisability of seeing that such bearings are quite above suspicion before the machine so fitted is started.

Moulding sand, however, is not always to be blamed for seized bearings—on new machines, at any rate. A handful of clean waste, of average shop quality, often holds in suspension enough gritty and other foreign matter to cause not a little alarm to the intelligent and conscientious user. Again, the precaution of cleaning out thoroughly new bearings *on site* is not always appreciated properly. Almost invariably, after a machine has passed test, and previous to packing, the bearings are emptied of lubricant, but seldom indeed is provision made for exclusion of dust or dirt during transit to the customer. In shipping on and off rail, in slinging, &c., there are a score of different ways in which dirt, mud, and the like will, often unavoidably, become deposited in the bearings. The inside walls being more or less sticky the dirt adheres thereto, on flypaper principle, and if too much is taken for granted because the machine tested out satisfactorily, trouble sooner or later ensues; naturally, gritty matter is found, and a qualitative observation pronounces foundry sand, whereas, as likely as not, the disturbing cause will have had a more prosaic origin, probably a scraping of mud from a careless slinger's boot.

For obvious reasons some form or other of cable lug or thimble should always be used even for the smallest size of stranded cable. A good pattern of mechanical terminal device (proprietary) is on the market, which provides an efficient and neat attachment, especially for flexible cording; with the latter, efficient soldering is often a somewhat difficult matter where shop facilities are not obtainable. For heavy service the lug or thimble socket should always have at least one set-screw provided, not merely as a precautionary measure, but to ensure rigidity between cable and socket during the sweating operation.

A coat of white paint or enamel on the inside of a motor-shell is often of advantage, as it facilitates cleaning and elucidation of connections, especially where motors are located in dark and out-of-the-way places. As an aid to cleaning, a portable air-compressor is practically indispensable; and there are objections to the employment of hand-bellows or syringes.

In conclusion, by far the majority of electrical accidents occur through carelessness or neglect to take proper precautions in working. For instance, a properly-shaped screw-driver is somewhat of a rarity, and many mishaps have been caused through using an ill-shaped driver. In fig. 24 are shown correct and incorrect ways of forming a screw-driver nose. It is well, too, to remember that there is a limit to the versatility of the otherwise useful cutting-pliers. A stock of suitable insulated spanners is a good investment, and a pair of thin skin insulating gloves should never be despised, as they provide, at any rate, an excellent insurance against undesirable eventualities; and this rather special class of risk is not, as yet, comprehended in the now common insurance coupon-policy of the daily news-sheet.

To Develop Spanish Industries.—The Spanish Society for Promoting National Industries (El Fomento del Trabajo Nacional) is offering a prize of £200 for any new invention, process or improvement in the departments of electrical or mechanical engineering tending to the progress and advancement of the country's industries. Particulars of the offer may, we understand, be obtained from the Secretariat del Fomento, 4 Plaza Santa Anna, Madrid.

AMERICAN ELECTRIC COOKING CONDITIONS.

AN instructive report on the subject of electric cooking conditions in the Western States was presented at the Portland Convention of the N.W. Electric Light and Power Association, in September last. In the area to which the report refers there are 389,842 domestic electric lighting consumers, of whom 220,042 are using gas for fuel, and 2,481 electricity, leaving 167,319 homes which use some other form of fuel, and the authors consider ways and means of securing a large proportion of the latter as electric cooking consumers in the next few years.

The figures are interesting, as showing the approximate scope of future business in the area considered, also because it is evidently felt to be either unnecessary or undesirable to compete with the existing gas cooker business.

No doubt a similar feeling exists in many of our own cities, where the dual interests of gas and electricity are under municipal control, but the fact remains that in this country the gas cooker has monopolised this class of business for so many years, and so effectively penetrated into the houses of practically every class of consumer, that electric cooking must necessarily be—and even now is, in a small way—in competition with gas cooking here.

Much has been written and spoken in this country on the huge possibilities of the electric cooking load, but we doubt whether any British central station engineer possesses reliable data as to the existing cooking methods employed in his area, or, for the matter of that, as to the type of cooking employed by his own electric lighting consumers.

To return to the report: many of its conclusions cover ground familiar to our readers, as, for instance, the belief expressed that the ultimate residential rate will be one with a fairly high minimum bill, thus allowing the central station to furnish supply through one meter.

But the average American consumer must be blessed with a singular amount of patience and understanding if the typical rate cited of the Buffalo General Electric Co. is a sample of future tariffs, and for our part, we prefer the several types of "domestic" tariff adopted in this country, with all their oft-criticised shortcomings.

The Buffalo rate is as follows:—

8 c. per KW.-hour for first 60 hours' average monthly use of maximum demand.
5 c. per KW.-hour for next 120 hours.
1½ c. per KW.-hour in excess of 180 hours.
No maximum demand figured less than 250 watts. Maximum demand taken as 25 per cent. of total installation, not including irons, heating devices, cooking devices, fans, vacuum cleaners, and utility motors, not exceeding ½ H.P. in size.
Discount 1 c. per KW.-hour on primary rate. $1 minimum.

The subject of tariff making in its relation to the consumer and central station is an old story with us, and it is unlikely that we shall learn anything from our American friends in this respect.

Every tariff is in effect a compromise between the rival demands of a particular class of consumer and the central station; to attempt to individualise charges, in fact, to "make the punishment fit the crime," literally, as some people desire, is usually to court failure, for the true criterion of success in tariff making is the ultimate effect on the central station of the consumers *en masse*, and the tariff which is sufficiently involved to study the idiosyncrasies of the individual is too complicated for commercial use in this country.

It is considered in the report that electric cooking business can be secured with energy at 1½d. per unit, because of its inherent advantages and the less shrinkage of electrically-cooked foods, and many consumers using this rate insist that their monthly bills are no greater than when cooking with gas—presumably costing from 3s. to 4s. per 1,000 ft.; investigators who are also interested in the gas business, however, believe that electricity at 1d. per unit more nearly equals gas at the prices mentioned.

For heating water a rate of ·4d. to ·5d. per unit is considered necessary, though unprofitable and only justified because it may lead to the securing of the cooking load at a higher rate. The idea is to use low wattage heaters connected during the night or all day, except when the range is in use.

On the subject of competition with gas, the views of the combination gas and electric men, set forth by one of them, should be appreciated on this side.

As to the reasons why there are very few consumers cooking with electricity, even where the 1d. electric rate is given in competition with a gas rate of 5s. 3d. ($1·25) a thousand cb. ft., he points out that the most important is "that people have become accustomed to cooking with gas and are equipped with gas stoves, water-heaters, and other devices, and do not like to change from something they know to be satisfactory to something that is in an experimental stage." Again, the first cost of an electric range is cited as another drawback, and such apparatus is unlikely to be adopted, he considers, until the price is lowered considerably. A further reason given is the lack of an electric water heater which is as satisfactory as the gas water heater. Hot water being a household necessity and mixed apparatus being undesirable, he believes that cooking by electricity will be restricted until the right pattern of water heater is introduced.

As regards the first two reasons given, we may as well realise that the gas cooking habit in this country is due in great part to the low cost at which the consumer can obtain the necessary apparatus, which can be hired on most reasonable terms in the great majority of cases—terms so low, indeed, that one suspects future gas consumption bears a proportion of capital charges.*

The price of electrical cooking apparatus, on the other hand, is such as to effectively deter its general adoption, so that no body of public opinion in its favour is likely to result for sometime—although the number of individual opinions, very favourable to electric cooking, is growing rapidly. However, the gas-electric official goes on to admit that :—

> There are certain obvious advantages in cooking with electricity, as compared to cooking with gas, such as greater cleanliness in the use of electricity, the fact that electricity does not burn up any of the oxygen in the room, thus, making an electric kitchen a healthier place in which to work, and possibly more important than either of the above, it has been found by actual test that food cooked by electricity contains more of the original weight than when cooked by gas. In some cases the saving amounts to from 15 per cent. to 25 per cent. of the original weight. As an instance, in broiling a steak the gas flame consumes considerable of the juice which has a very high nutritive value; with the electric broiler the juice is all saved, as there is no flame. With electricity the heating is under absolute control and exactly the right temperature can be maintained for any operation; with gas, no matter how careful the cook may be, there is bound to be considerable variation and the same condition of heat cannot be assured on all occasions.

He concludes that the gas business in general will not be hurt, but will be improved as electricity becomes more of a competitor, and with this the authors of the report agree.

In discussing "selling policy," the report advocates the necessity of the central stations doing the bulk of the selling of apparatus under present price conditions; that deferred payments should be allowed; and that costs of wiring should be averaged and included in the contract for the installation, although, as an introductory argument, it is suggested that the stations may find it advisable to absorb the wiring cost.

It is probable that before any great advance can be made in the adoption of electric cooking in this country, a co-operative movement on the part of the central stations for the purchase of apparatus will have to be introduced, with a view partly to introducing a degree of standardisation in apparatus, and discarding any special features which experience with gas cookers has shown to be quite unnecessary, and which consumers are unwilling to pay for, and partly to guaranteeing the manufacturers' output in return for such a reduction in price as will enable competitive hiring rates to be offered.

In a leaderette bearing on this matter, the *Journal of Electricity, Power and Gas*, which also abstracts the report, says that "before any great increase in sales can be expected . . . the cost of electric ranges should be materially reduced. This should be possible with standardisation of design, just as has been done in the case of vacuum cleaners, which sell for less than one-fourth the price quoted five years ago, and is being done in the case of electric washing machines."

We entirely agree with our contemporary as to the necessity of introducing some degree of standardisation as between the various makers of cooking apparatus, although the subject is beset with greater difficulty here, where things are made to last years, than in the States where very often "a short life and a merry one" appears to be all that is asked for and provided for, and where, consequently, improved standards can be more frequently introduced.

The only solid argument against standardisation—on the score of its hindering the introduction of improvements—is worn somewhat threadbare in view of the fact that the most acceptable general type of apparatus has already been settled for us by our gas friends, to whom we should feel indebted rather than otherwise for having ascertained definitely just what will satisfy the average user of to-day.

If we can agree to so much, and it is apparent that a majority of the makers of electrical cooking apparatus do agree, in principle, then the problem is narrowed down practically to an agreement on one or two standard sized cookers, and the construction of electric heating devices within certain limiting dimensions, and having standard methods of attachment, and we doubt whether such restrictions, if it be conceded that they are commercially desirable, will hamper technical development to any undesirable or appreciable extent. Probably the reverse will be the case.

While it is well to keep the ideal always in view, our practical efforts will inevitably be influenced and severely limited by the prosaic question of what we can afford to supply at the market price, the latter being fixed for us, within certain limits, by economic considerations. Excellent as are the results obtained by electrical cooking, this factor cannot to any appreciable extent influence progress, because it is not realised by the public generally, and, indeed, cannot be until the apparatus is obtainable on somewhat similar terms to those offered with competitive apparatus. To paraphrase the historic recipe of a celebrated cookery-book, "To cook electrically, you must first get your stove."

* A recent *Gas World* analysis of a number of gas undertakings for the year 1914-15 shows average receipts from stoves and fittings—presumably from hire, hire-purchase, &c.—amounting to 1·21d. per 1,000 cb. ft. sold, against average maintenance costs amounting to 1·25d. per 1,000 cb. ft. sold.

Bradford is credited with receipts amounting to £917 and maintenance costs of £4,474; Salford, receipts £1,225, maintenance £9,531; Coventry, receipts £1,960, maintenance £4,842; Darlington, receipts £1,934, maintenance £3,246.

We do not, of course, know what proportions cooking apparatus bears to the total, but the principal underlying these transactions can be understood.

THE CORROSION OF METALS.

A GENERAL discussion on "The Corrosion of Metals" formed the programme of the December meeting of the FARADAY SOCIETY. Sir Robert Hadfield, President, who introduced the subject, was in the chair, and papers were read by Dr. C. H. Desch, who dealt with the effect of the physical nature of metals on the process of corrosion, by the President, Dr. J. Newton Friend, Mr. Lealie Aitchison, and Mr. S. Whyte, on various aspects of the corrosion of iron and steel, and by Mr. Arnold Philip and Mr. W. E. Gibbs, on the corrosion of brass. Amongst those who contributed to the discussion following the reading of the set papers were Prof. H. C. H. Carpenter, Dr. W. Rosenheim, Dr. E. K. Rideal, Mr. U. R. Evans, Mr. L. Pendrith, Dr. T. M. Lowry, and Mr. A. F. Dismore.

Numerous examples of non-corrodible metals and alloys and of interesting specimens of corroded metals were exhibited by Sir Robert Hadfield and Dr. Friend, and Mr. Robert Lennox had an exhibit of a variety of articles made of his well-known non-corrodible ferro-alloy known as "Tantiron."

General Considerations on Corrosion.—The importance of the subject is manifest, whether on the ferrous or non-ferrous side. With regard to the former, it is estimated that the world's annual losses of iron due to corrosion amount to hundreds of thousands of tons. To reduce this to a minimum is to conserve our national stores of coal as well as iron, so that the invention of a cheap and workable non-corrodible iron or steel is a work of considerable national value. In the non-ferrous field the matter is no less important when we consider the constant corrosion always taking place in condenser tubes, economisers, feed-water heaters, propellers, and a hundred other things in contact with fluids. A concrete illustration of the cost of preventing corrosion in a particular case will be of interest. To protect the boilers of the *Lusitania* and the *Mauretania* from corrosion, 84 pure zinc plates, each weighing some 20 lb., were used in each boiler, and these were renewed four times a year. This meant an annual cost of £8,400 per ship, at the present price of zinc.

Dr. Rideal, in the course of the discussion, defined corrosion as resulting from an irreversible change proceeding with a small velocity and taking place on the common surfaces between two or more phases, the products of which change are continually removed from the sphere of action. Provided the word "phase" indicates physical state (*e.g.*, state of strain or mode of crystallisation) as well as chemical composition, this definition suggests at once that corrosion is an electrolytic phenomenon, a result of numerous minute voltaic currents set up between the different "phases" on the surface of metals. This view would appear to be generally adopted, although, as will be seen later, there are differences of opinion as to what constitute the "phases" in the case of brass. As to the medium (or electrolyte on this theory), this may be the atmosphere, or some constituent of it, such as water vapour in pure air, or acid vapours in manufacturing towns, and special media such as gases in acid liquids. There is also corrosion by heating, but this is only a special condition of one or other of the above cases.

Methods of studying corrosion received a good deal of attention at the meeting. The ideal method is, of course, to test the material under normal working conditions, but this is too slow a process for ordinary purposes, and artificial corrosion has to be resorted to. In the case of iron or steel, simple immersion in water or acids has usually been adopted. In the case of brass, electrolytic corrosion—using the test piece as anode—in salt solution yielded instructive results, but it must never be forgotten that the results of a laboratory test must always be accepted with caution, unless it is certain that it imitates practical conditions. Another point strongly brought out in the discussion was the very different power of resistance to corrosion possessed by the same material under varying practical conditions. Thus an iron or a steel that will resist the Thames water has been found to be exceedingly corrodible in London air.

Another important aspect of the subject discussed, and it is often overlooked, was methods of measuring corrosion. Merely comparing losses of weight in laboratory experiments may be very misleading. It is necessary, as Dr. Desch pointed out, to distinguish the different forms in which the constituents are removed. The material, for example, may dissolve, the product of corrosion may be loose and flocculent, or adherent and protective; protective layers, indeed, of basic salts are quite an important factor in the resisting properties of metals. Again, corrosion may either take the form of pitting or of uniform surface action; obviously, a weight test in either case may lead one altogether astray. It is points such as these that render corrosion so difficult to investigate experimentally.

Corrosion of Iron and Steel.—Two main aspects were discussed, first, by Dr. Friend, the relative corrodibilities of iron and steel, and, secondly, by Sir Robert Hadfield and Mr. Aitchison, the influence on steel of the special additional metals now commonly employed—silicon, chromium, nickel, manganese, tungsten, vanadium, and others. Dr. Friend has come to the conclusion, and in this he was corroborated by some practical tests that Mr. L. Pendrith has been making, in conjunction with Mr. F. W. Harbord, that there is no simple answer to the question, which is the more corrodible, iron or steel? The answer depends both on the nature of the corroding medium and the standard of corrodibility to be adopted, and the problem really is, which is the best type of iron or steel for any particular purpose?

Sir Robert Hadfield's summary of the resisting properties of the steel alloys he has been working on for so long was most interesting. Confining ourselves to corrosion tests made in 50 per cent. sulphuric acid, it is noteworthy that the silicon and tungsten steels both have a minimum corrosive point, the former at 3·4 per cent. content, the latter at 2·2 per cent. On each side of these minima the rise in corrodibility is rapid. Nickel steels in this medium show a steady fall in corrodibility with increasing nickel content, while in the chromium steels there is a steady rise. These results show how important a factor is the corroding medium, for, in practice, nickel steels are not incorrodible, and although they often remain so until corrosion commences, they rapidly deteriorate after it has once set in. On the other hand, chromium steels in practice are highly resistive. As far back as 1892, Sir Robert Hadfield found that 10 per cent. chromium conferred on steel practical freedom from rust, and there is now on the market table cutlery made from what is known as "stainless" steel—because it does not tarnish in food or acids—containing from 10 to 12 per cent. chromium and 0·3 to 0·4 per cent. carbon. The mechanical properties of this steel, after suitable heat treatment, are also found to be excellent, and the possibility of using it for such purposes as dock gates is under consideration.

Mr. Aitchison's exhaustive experiments were in general agreement with those brought forward by Sir Robert Hadfield. The corrosion of steel in tap water, 3 per cent. sodium chloride and 1 per cent. sulphuric acid solution, increased with the addition of any third element up to about 5 per cent., with the exception of chromium, which conferred a permanent decrease of corrodibility (although it did not do so in 10 per cent. sulphuric acid). Generally speaking, high chromium steels were the only ones which showed to any real advantage over pure mild steels. The effect of varying amounts of carbon in pure steels was interesting, for it *decreased* the corrodibility up to about 0·5 per cent., increasing it above that point. This was significant, commented Dr. Rosenheim, for it was the second property of steel reaching a critical point at that carbon concentration. Mr. Aitchison subjected all his specimens, both before and after corrosion, to microscopic examination. It appeared that even in pearlite it was always the ferrite which was attacked, by the production first of etching pits, which spread gradually over the whole area. The carbide was always unattacked, and simply dropped away mechanically, but it acts as an aid to corrosion, by providing a definite cathode for the ferrite or for any solid solution present acting as ferrite. Twinning increased corrodibility. It was strange that one of the least homogeneous of the materials examined—a 20 per cent. chromium steel—was corroded least. Mr. Aitchison considers that the true secret of non-corrodibility lies in some property of the solid solution—perhaps its solution pressure—which is to be found as a consequence of its chemical composition, coupled with heat and mechanical treatment. The solution pressure of iron itself is never low enough to prevent corrosion.

Mr. C. F. Dismore, in the course of the discussion, claimed to be able to convert cast-iron, with a high carbon contact, into non-corrodible steel, by an electrolytic process which he had hit upon. This rather startling claim was received with a good deal of scepticism, and we must await further evidence before accepting it. If it were a mere skin effect it would be intelligible, but the claim went far beyond that.

The Corrosion of Brass.—In lieu of the usual theory that the corrosion of two-phase brass by sea-water is due to the action of electrolytic currents set up by minute couples of adjacent crystals of metals of different phase, Mr. Arnold Philip put forward for consideration the view that it is minute zinc-copper couples that act as voltaic cells. In auto-corrosion the current would flow from the zinc element, forming zinc chloride, to the copper forming caustic soda and depositing hydrogen. Thus polarisation will stop further action unless oxygen is present to counteract it. If it is, dezincification takes place, with separation or corrosion of copper. The theory is also shown to support the well-known fact that higher zinc content, such as in Muntz's metal, lowers the rate of corrosion, a fact otherwise difficult to explain, for a 70/30 brass is a single-phase, and 60/40 brass a two-phase system. Mr. Philip discussed at some length the cases of contact-corrosion and the corrosion of brass by external current, and he worked out expressions giving the relative magnitude of the action in those cases which, he said, agreed with observation.

Mr. Philip's theory was not kindly received. It was pointed out that if brass really were a mosaic of copper and zinc, corrosion would take place much more rapidly than it does. The evidence of the microscope and the equilibrium curve showed that the view that there is no chemical combination between the constituents of brass is quite untenable, and that it was highly improbable that zinc and copper could exist side by side in brass. Moreover, zinc in contact with copper should go into solution more easily than zinc alone, and the copper should not dissolve at all. This is not the case, and the E.M.F. of brass in sea-water resembled that of copper rather than zinc, while a mixture of brass and zinc, said Mr. Gibbs, had the same E.M.F. as pure zinc—a questionable statement, in our opinion. Mr. Gibbs himself, who, by the way, is at present acting as honorary investigator on the Corrosion Committee of the Institute of Metals, also, in his paper, dealt with the sea-water corrosion of 70/30 brass, and in this he arrived at the conclusion that a solid solution of zinc and copper is intermediate in character between a physical mixture and a chemical compound. There probably exists, he thought, a kind of "physical" combination in which the chemical character of the constituents is not changed, but only modified. Apart from its theoretical considerations, Mr. Gibbs's paper contained a great deal of valuable information on the influence of a number of important factors upon the rate and character of the corrosive attack of sea-water on brasses, and those interested are advised to refer to the original paper.

At the conclusion of the discussion, Mr. Elliott Cumberland gave a demonstration of his electrolytic process for preventing corrosion of all metals immersed in liquids. The method consists in introducing a higher counter E.M.F. than that causing the corrosive action, and it has proved itself to be the only effective method of overcoming the dezincification of condenser tubes. Continuous current is supplied from a 10-volt dynamo to pieces of iron suspended in the liquids, which act as anodes, the cathode being the metal protected. The anodes last from 18 months to two years, and the cost of the current, too, is inconsiderable, on account of the low voltage. The system has been installed in many steamships with, it is stated, highly successful results.

TECHNICAL EDUCATION.

THE continuation of the war is by no means preventing the consideration in different belligerent countries of the important problem of the supply of skilled labour after the conclusion of peace and the indirect part which education at the present time should play in the production of future artisans and professional engineers. As a newspaper correspondent stated a week ago, the professions, like other lines of life, will then have been deprived of much valuable material, and the question now is to give a good education to those boys with whom the future of England lies. In this connection attention is again drawn to the county scholarships which assist boys on from stage to stage until they reach a university. But the war has made heavy calls upon the teaching profession, and further demands in this direction are in early prospect. It is for this reason that the important conference of teachers and others interested in education, including representatives of the County Councils' Association and numerous educational associations, recently adopted a resolution expressing the opinion that as the national prosperity at the close of the war will largely depend upon the supply of young citizens well trained for the full discharge of national obligations, no curtailment of the provision

of higher education should be made, evening school work should be continued, and the children of poor parents should be enabled to take advantage of such facilities by means of scholarships.

The question is also attracting attention in France and Germany. In the former country, although a scarcity of labour in general prevailed before the war and will become aggravated on its conclusion, most consideration appears for the moment to be devoted rather to the problem of the production of mechanical and electrical engineers than to the improvement of the training of youths, which is the more necessary, so as to form them into skilled workmen. In this connection M. J. H Jacobsen, discussing recently the proposed development of the French electrical engineering industry, asked whether the manufacturer who was endeavouring to apply the methods of intensive production was sufficiently seconded by his staff and workmen. The reply given by this French engineer was a negative in general. He, however, apparently absolves the workmen from any blame from a technical point of view, because their education is incomplete, and their social difficulties prevent them from acquiring the requisite qualifications on their own account, but nothing is said in regard to the degree of their diligence. The course of workshop instruction and study, in his opinion, should not only be free of any expense to apprentices, but, as soon as they begin to show the least efficiency, they ought to be paid so as to permit them to carry their practical education to a conclusion. We will not follow M. Jacobsen in his observations in regard to the staff beyond mentioning that one of his ideas is that the manufacturers can help the staff and at the same time assist themselves, but will now turn to Germany, where an important pronouncement was recently made, not by an educationist, but by the general manager of the large engineering undertaking known as the Augsburg-Nuremberg Machinery Works, in a paper presented to the Association of German Engineers, on "The Engineer as a Promoter of National Education." As was mentioned in this journal several years ago, Germany was then ove flowing with highly-trained professional men of most classes, including engineers, and the only result at that time was the production of a superabundance of men for whom no profitable occupation was available. But the turn of these men apparently arrived with the preparation for and the course of the war. The idea of the general manager of the company in question now is that this process should be repeated on a grand scale for the whole of the country, so that every competent youth should become a highly educated and skilled workman, and that this form of education should be absolutely free. But let the general manager speak for himself :—

Dr. von Rieppel stated that German culture and civilisation would lead the economic life of the country to further prosperity after the termination of the war. It was, however, necessary for that purpose that the former hatred between parties and classes should not blaze up again, but that the present unity should be permanently maintained. Apart from religious differences, the division in the nation in the past existed principally between workmen and employers, that is between two classes dependent upon each other, and between whom stood the engineers by reason of their profession. In his opinion the dividing antitheses were founded solely and only upon different conceptions of the duties and rights of citizenship of the individual in relation to the whole community. To need self-comprehension the young citizen, irrespective of whether he would be a future employer or workman, must first be instructed in these rights and duties and in the problems of a system of State. The schools, however, scarcely devoted any consideration to this side of education, and in the widest circles there was a lack of understanding as to its importance. Although the war would clear away many preferences and prejudices, it would not do so in such a fundamental manner as to maintain unity over the conceptions of the leaders of parties and classes after peace came. The problem would consequently remain for them as to how they as engineers, without occupying themselves with politics, could support in their own circles the efforts to mitigate the antagonism of classes in the sense and spirit of the rules of the Association. The author considered that that was possible if they restricted themselves to the education problems comprised in the matter, which he regarded as (1) the equal possibility of education for all classes of the nation ; and (2) education in citizenship. As to the first point, Dr. von Rieppel remarked that the opinion was gaining ground that the sharp division between elementary schools and intermediate schools could not be permanently maintained. The premature transfer from the former school to the latter, which was now stipulated at the age of nine or 10, must be discontinued ; an organic connection must be established between the two schools. But the school fees must be remitted in order to facilitate the attendance at school of talented children of poorer fellow-citizens. The German elementary school occupied the first position in regard to system and compulsory extension over the country. On the other hand, the American school, with its greater versatility and the greater incentive which was given to the children for higher education, was better for the great masses of the population. In particular, the American school was superior to the German in the sense that it formed the basis for each further study, everyone having the possibility of climbing to a higher stage. The premature transfer of pupils of middle class families to the classical school, which now took place in Germany at the tenth year, brought about a keen division in the great masses of the population, and it was all the more unfortunate as it was regarded as a privilege of wealth. This division had the further unfavourable influence of causing the better educated children of the higher classes of citizens to be excluded from intercourse with the lower classes of the population. The sharp antitheses which existed were, therefore, not to be wondered at. The possibility only existed to an inadequate extent for the continued professional and citizenship education beyond the school obligation incidental to the elementary and continuation schools, whilst Germany occupied the last position in regard to public libraries. The nation had reached such a high degree of welfare that juvenile labour in industries was able to be entirely dispensed with up to the 14th year. But the higher grades of the national schools should be so improved that a transfer would be possible to the practical schools at the age of 14 without loss of time. This object could be achieved by slightly restraining the special instruction branches in the practical schools, and by advancing the instruction in the national schools. In this way, the German would obtain the equal of the American organisation by means of a kind of intermediate school. A large portion of the German classes of the population would thereby find the way open to higher aims still at an age when an opinion could be better formed as to the special talents of a child. If to this were added complete freedom of instruction in the national and practical schools or higher practical schools, a path in an upward direction would be opened to education in the lower layers of the population. This step, in the opinion of the author, would remove many grounds for dissatisfaction, and the attachment to the institutions of the State would be advanced. The particular German State which had the courage to establish an organic connection between the eight classes of national schools and the five classes of higher practical schools would be glorified for this action by the nation in future years.

It is impossible for us to follow at any length the observations made on the second point raised by the general manager. His argument, however, lies in the direction of showing that, after leaving the elementary schools for the continuation schools, the scholars should be instructed in the privileges, rights and obligations of citizenship, so that, instead of merely forming one-sided ideas on the subject and on the compulsory necessities of the economic life—fostered, as they are, by certain newspapers in the years intervening before they enter the army at the age of 20—they would fully understand both sides of the problem, and would become better citizens and better workmen. It is, therefore, contended that engineers and technical men in general should render assistance in the execution of this programme for the benefit of the community. Naturally, the scheme is merely a paper outline at the present time, although it has secured advocates in other circles. It would not, however, be surprising if something were done after the war generally to improve the technical education of the boys, quite apart from what will be accomplished, or is being carried out in connection with the education of soldiers partly disabled through the war. The Krupp Co., for instance, is already offering besides reinstating returned soldiers or re-employing them as far as possible—not for office work or as messengers, &c., but in the shops themselves—to grant financial assistance to competent men to attend classes in machine construction. We must, therefore, not overlook what is proceeding in other countries in order that we may be better prepared on the conclusion of peace for the great industrial conflict of the future, than we were for the disastrous war of the present.

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

By J. R. BEARD, M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *December*, 1915.)

(*Concluded from page* 30.)

Most Suitable Distribution Voltage.—In settling the distribution voltage the primary consideration is that it shall be sufficiently high to ensure that the voltage variation at the boundaries of the supply area can be kept within a reasonable amount without putting an excessive amount of copper in the feeders. It is usually desirable that the voltage variation should not exceed 5 per cent. either side of the normal, *i.e.*, a total of 10 per cent., and from this about 2½ per cent. should be deducted for transformer voltage-drop, leaving a permissible maximum drop of 7½ per cent. in the high-pressure mains. Fig. 5 shows that under the same conditions the current density in the mains, and therefore the resistance voltage-drop per mile, is approximately independent of their section. The actual figures taken from fig. 5 are given in Table V.

As the power factor of most distribution systems is less than unity it is also necessary to take account of the inductive voltage-drop. This is not independent of the section, but given the current density from Table V and the frequency of the system it can be readily calculated from the size and spacing of the conductors. Fig. 9 shows, for several typical sizes of both underground and overhead mains at various voltages, the relative amount by which the inductive drop increases the total voltage-drop at various power factors. The calculations are based on a frequency of 50 cycles per second and on a constant current density, since the economical value for the latter is independent of the power factor. They also assume the use of ordinary 3-conductor mains; if

arranged for split-conductor protection the inductive drop would be appreciably reduced.

TABLE V.

Type of main.	Amperes per square inch at maximum load.		Resistance voltage drop between phases per mile at maximum load.	
	With the economical loading.	With decreased loading corresponding to 5 per cent extra cost.	With the economical loading.	With decreased loading corresponding to 5 per cent. extra cost.
Underground mains up to 11,000 volts	910	635	68·1	47·5
20,000-volt underground mains	1,190	800	88·8	59·9
Overhead mains up to 20,000 volts	800	540	59·9	40·4

It is evident that the maximum radius of distribution and area of supply at a given voltage will vary according to the power factor of the system and to the various factors which determine the inductive drop, but in order to give an approximate idea of the relative figures for the maximum radius and area at various voltages the curves given in fig. 10 have been prepared on the following assumptions:—Permissible voltage-drop, 7.5 per cent.; average power factor, 0.8; a network comprising equal lengths of underground and overhead mains; an average cross-section of main of 0.15 square inch; a frequency of 50.

It is interesting to note that, although it is more economical to run higher-voltage cable at an increased current density, the curves of both area and radius have still a steep upward tendency at 20,000 volts. This would be further accentuated if allowance were made for the fact that the average cross-section of main tends to decrease at higher voltages, with a corresponding decrease in the value of the inductive drop relative to the resistance drop.

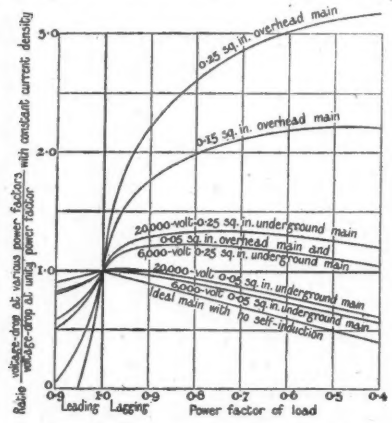

0·25 sq. in. overhead main
0·15 sq. in. overhead main
20,000-volt 0·25 sq. in. underground main
0·05 sq. in. overhead main and
6,000-volt 0·25 sq. in. underground main
20,000-volt, 0·05 sq. in. underground main
6,000-volt 0·05 sq. in. underground main
Ideal main with no self-induction
Ratio voltage-drop at various power factors / voltage-drop at unity power factor
Leading Lagging
Power factor of load

FIG. 9.—EFFECT OF INDUCTIVE DROP AT DIFFERENT POWER FACTORS FOR VARIOUS MAINS.

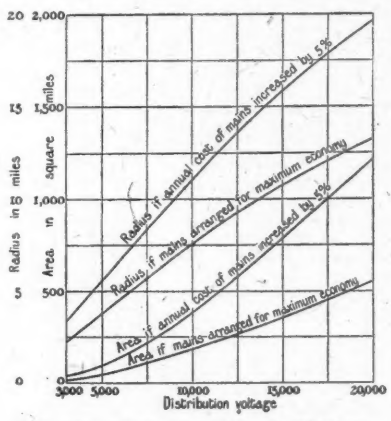

Radius if annual cost of mains increased by 5%
Radius if mains arranged for maximum economy
Area if annual cost of mains increased by 5%
Area if mains arranged for maximum economy
Radius in miles
Area in square miles
Distribution voltage

FIG. 10.—RADIUS AND AREA OF DISTRIBUTION AT VARIOUS VOLTAGES.

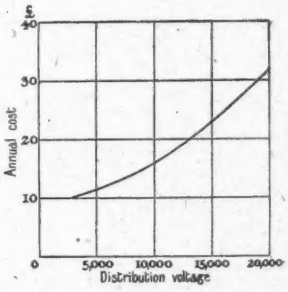


FIG. 11.—ANNUAL COST OF SWITCHGEAR PER PANEL.

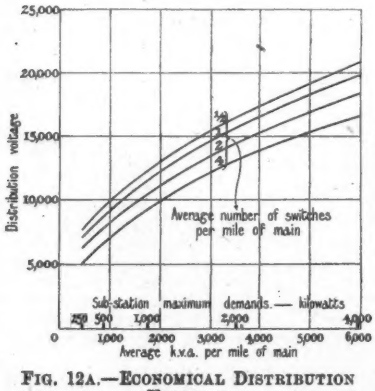

Distribution voltage
Average number of switches per mile of main
Sub-station maximum demands — kilowatts
Average k.v.a. per mile of main

FIG. 12A.—ECONOMICAL DISTRIBUTION VOLTAGE.

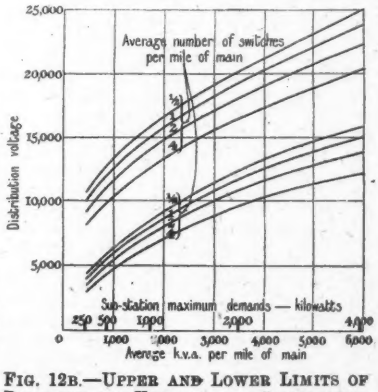

Distribution voltage
Average number of switches per mile of main
Sub-station maximum demands — kilowatts
Average k.v.a. per mile of main

FIG. 12B.—UPPER AND LOWER LIMITS OF DISTRIBUTION VOLTAGE FOR 5 PER CENT. INCREASED COST OF DISTRIBUTION SYSTEM.

It is, however, not sufficient to settle the distribution voltage on the basis of permissible voltage-drop alone. It is also important to choose that voltage which gives the cheapest distribution system, and from this point of view it may often pay to use a voltage much higher than that which is required by the conditions of voltage-drop. Generally speaking, the higher loads which have to be dealt with, the higher is the economical voltage; but it is also necessary to take into consideration the proportion between the total number of switches required and the total mileage of mains, as the cost of switchgear increases with the voltage. Fig. 11 gives fairly safe figures for the annual cost per switch at different voltages on the basis of annual charges of 8 per cent. on the switchgear and the corresponding building accommodation, and these figures have been used in the following investigation.

Taking a system comprising 24 sub-stations evenly spaced as in fig. 8 (*a*), and allowing an average of 2¼ switches per sub-station for controlling the step-down transformers, the total annual cost of switchgear and mains has been calculated for various distribution voltages and various sub-station loadings. In addition, the spacing of the sub-stations has also been varied so as to give several comparative proportions between the number of switches and the mileage of mains. From these results the series of curves given in fig. 12A have been plotted showing the most economical voltage under the varying conditions.

It will be seen by reference to fig. 6 that the annual costs of mains of varying sections lie approximately on straight lines, and it is therefore permissible, by plotting the curves in fig. 12A to a base of average demands, to make the results applicable to any arrangement of network whatever its type or extent. In order to find the most economical voltage for a given distribution of loads, the procedure would then be to assume a voltage which it is anticipated will be about correct, to lay out the distribution system on this basis, calculate from this the average number of kilovolt-amperes per mile of main and the number of switches per mile of main, and then from these two figures find from the curves in fig. 12A what the most economical voltage would be. If the original voltage which had been assumed should prove to have been so incorrect that the arrangement of feeders and the number of switches would be appreciably altered by the adoption of the revised voltage, it may be desirable to lay out the system afresh with the revised voltage and afterwards check the results again with the curves in fig. 12A, the method being thus one of trial and error. As a rule, however, the first voltage assumed should be sufficiently close to the correct figure to enable the latter to be obtained by the first trial. The economical voltage obtained in this way must, of course, be always checked to ensure that it also meets the requirements of voltage-drop.

In order to give some idea of the extent to which the economical voltage can be departed from, the curves given in fig. 12B have also been calculated; these show the upper and lower limits of voltage corresponding to an increase of 5 per cent. in the cost of the distribution system. The limits are fairly wide, but, if they are exceeded, the extra cost of the distribution system increases at a cumulatively rapid rate. In practice it is advisable to adopt a voltage in the neighbourhood of the upper limit in order to keep down the voltage-drop as much as possible and also in order to make allowance for the increase in the density of load which will usually occur.

As might be expected, fig. 12 shows that the heavier the loads to be supplied and the more they are concentrated the higher is the most economical voltage. It should be noticed that the curves show no signs that at 20,000 volts the maximum economical voltage has been reached, provided the system loading is heavy enough, and hence for the larger systems of the future we may expect that for economical reasons alone the distribution voltage will be raised above 20,000 volts.

These calculations only refer to underground mains; with overhead mains the economical voltage will be higher, since there is so little difference between their cost at various voltages.

In order to see what are typical figures in actual practice for the number of switches per mile of main and the average number of kilovolt-amperes per mile of main, the following table has been prepared for two typical systems for which the author has had access to the necessary data, and as a matter of interest the corresponding economical and limiting values for the distribution voltage have been deduced from fig. 12.

TABLE VI.

System voltage actually adopted	5,500	20,000
Number of switches per mile of main ...	2.63	0.725
Average maximum kilovolt-amperes per mile of main	450	3,500
Most economical system voltage	5,700	16,000
Upper and lower limits for system voltages with 5 per cent. extra cost of distribution system	9,500 3,200	20,000 12,000

In conclusion, the author wishes to record his obligations to the Newcastle-upon-Tyne Electric Supply Co., Ltd., and associated power companies on the North-East Coast, and to their consulting engineers, Messrs. Merz & McLellan, for permission to use much of the data on which the conclusions of the paper are based.

SOME DIFFICULTIES IN THE DESIGN OF HIGH-SPEED GENERATORS.

Prof. A. B. FIELD'S paper on this subject was discussed by the MANCHESTER LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS on November 30th, 1915. An abstract of the paper was given in the ELECTRICAL REVIEW for December 3rd, 10th and 17th, 1915.

Prof. MILES WALKER assumed that the author did not advocate a departure from the solid type of rotor in cases where the stresses were not as high as in large machines run at very high speeds. The rotor winding shown in fig. 8 had been proved to be perfectly satisfactory to use in ordinary shop practice, but for large rotors dealing with many thousands of ampere turns per pole at high peripheral speeds, a better winding could be put forward. [Prof. Walker then described a winding, details of which were given in our report of the London discussion.] The plan of getting the stator coils a long way back from the rotor was very good. If the slots were made 3 or 4 in. deeper than at present, it would be possible to get quite a wide space between stator and rotor coils; this permitted of sufficient leakage flux to cut down the stator current on short circuit and obviated the necessity of providing an expensive reactance coil, which caused a certain amount of loss. The extra depth of slot provided a good cooling surface which could easily be cleaned. The general mechanical arrangement was much preferable to the type of machine where everything was bunched near the rotor with only ventilation behind—here they had the ventilation in front on the rotor side.

Mr. F. A. KUYSER described a system of ventilation which eliminated some of the objectionable features of axially ventilated machines. In the case of an 8,000-K.V.A. 2,400-R.P.M. machine, axial vent chambers were provided in the usual way by means of holes punched in the core laminations. Nine radial air ducts, each ¾ in. wide, were provided instead of one central duct. Each axial duct was, therefore, divided into ten equal sections, which were connected together by means of a system of axial tubes welded to the ventilation spacers. At certain places the connecting tubes were left out and semi-circular distance pieces used which allowed the air to escape from the axial ducts to the radial ducts. The air outlets were evenly distributed over the whole length of the core, an equal number of axial ducts delivering to each radial duct. In addition to the elimination of the large central discharge, another advantage could be obtained by arranging the air streams to secure a counter-flow action, the air streams in adjacent ducts having opposite directions of flow. This arrangement reduced the high temperature which occurred near the air outlet of axially ventilated machines and equalised the temperature over the whole length of the core. In connection with stator coil bracing and the type of armature winding for turbo-generators, the diamond type of winding illustrated in the paper had been extensively used in the United States. A disadvantage of this winding was the open slots, which introduced extra losses; if wide slots were used, magnetic wedges were absolutely essential. Concentric winding had the advantage that each bar could easily be replaced without disturbing the remainder, but, generally speaking, a breakdown necessitated complete rewinding. The semi-closed slots were also of advantage. Referring to rotor coil bracing, he gave an example of a 15,000-K.V.A. 1,500-R.P.M. 2-pole machine having a radial forged rotor of 46 in. diameter weighing 22 tons. The torque developed on short-circuit was, roughly, 15 times normal, and this produced a force of 15 lb. acting on each lb. of copper. The maximum deflection of the winding, which was 1¼-in. width copper, was .015 in. If only the fly-wheel effect of the turbo was taken into account the deflection was .008 in. These figures suggested that a substantial field strap would suffice to prevent damage after a short-circuit without extra bracing, and this was verified in actual tests on machines of 15,000 KW.

Mr. G. D. SEATON said there was no less than 100,000 KW. of high-speed generating machinery out of commission in this country. The speed did not seem to be the source of trouble, as in almost every case it was the stator that proved defective.

Mr. JUHLIN said the author's figure of 20,000 lb. for the stress inside the rotor was probably under rather than over the mark, and in order to secure the disks on a through shaft it was necessary to shrink them on with stresses considerably above the running stresses. It was also required that the disks should fit the shaft when running at maximum speed; otherwise the disks would float, which was not permissible. Fortunately, this country was well situated to obtain steel forgings of large and small sizes, and for that reason it was probably unnecessary to adopt a disk construction until very extreme sizes were encountered. British steel makers were prepared to supply very large rotors having excellent physical properties in both radial and tangential directions. American steel makers had not yet been able to guarantee such radial test pieces. The following details represented the procedure adopted by one of the leading British steel makers in the manufacture of large rotors:—An ingot of approximately 115 tons and 94 in. in diameter would be issued, 50 per cent. being cut off at the top end to ensure homegeneity of material. A 12,000-ton press would forge the ingot down to the required diameter, the ends being forged down in a smaller press. The reduction in area would then be about 2½ to 1, so that the work done was quite considerable. After rough machining the rotor would be thoroughly annealed, and in this process probably more was done to the quality of the steel than was generally appreciated. Regarding the internal stresses, which were very high unless the material was treated exceedingly carefully, it was to be noted that in the finished rotor there were radial ducts dividing the rotor into sections to a considerable depth, 6 to 8 in. These ducts would materially tend to release the stresses in the longitudinal direction. The slots for the coils and the ventilation ducts under the slots would to a certain extent release the stresses in the tangential direction, so that in the finished rotor the remaining initial stresses should be fairly well released. The critical speed could be calculated much more accurately in the case of the solid rotor, and the stiffness of construction permitted a smaller diameter for a given output, which would give a slightly better efficiency. It would also be possible to use self-contained blowers in many cases where, with the author's construction, the increased length would make it impossible. By placing the slip-rings outside the bearings, the distance between bearings was considerably reduced, and at the same time another objectionable feature, high peripheral speed, would be obviated; greater accessibility to slip-rings was also obtained. The ultimate cost of a rotor constructed of plates would probably be slightly less than the cost of the solid rotor.

Mr. A. E. MCKENZIE expressed appreciation of the 3-part wedge, and referred to the great difficulty of making a satisfactory job of a solid wedge perhaps 6 or 7 ft. long with the present high peripheral speeds giving a stress of about 1 ton per square inch at the surface of the key. Considerable trouble had been experienced owing to keys working loose, even after insertion with pressures of 20 to 25 tons per square inch. There were advantages undoubtedly in having external reactances, particularly when a fault developed on the windings adjacent to the machine terminals. In such a case, high internal reactance would be of little use in reducing the shock to the system. The Manchester electricity department had recently specified that all large machines should be built to withstand a short circuit at the main terminals, when running fully excited at normal speed, but under present conditions they hesitated to apply the test. He had recently inspected tenders for 15,000-KW. machines having the internal reactance so high that a short-circuit current value of only seven times the normal was obtained. He had seen several mechines having windings of tubular or rectangular form to enable air to pass through the conductor. The cooling would undoubtedly be more effective in these designs than where the cooling air came into contact with only a small portion of the conductor periphery. The circular conductor was much better to insulate than the rectangular type, which tended to cause fracture at the corners. He had known of considerable trouble in the past with built-up rotors; the solid rotors had, however, given no trouble whatever, and he would be sorry to have to revert to the older types. Temperatures of 120 deg. C. to 180 deg. C. were only possible wth mica-insulated machines.

Dr. G. W. WORRALL dealt with the use of fans on rotors, and advocated the use of external fans in nearly all cases; a better system of ventilation was obtained, and nothing was lost from the point of view of overall efficiency. Axial ventilation was preferable to radial ventilation, and ventilation systems should be arranged so that all air ducts could be thoroughly cleaned. He had experienced considerable trouble due to breakdown of end windings of rotors; it was almost impossible in building up machines to apply the actual pressures to windings which occurred in practice.

Mr. R. TOWNEND said that the type of rotor described by Prof. Walker had proved highly satisfactory. In all cases the temperature of the windings had been very low. Large

losses occurred due to eddy currents in different parts of a turbo-alternator, amounting to 2 per cent. or more of the normal output of the machine; if this eddy-current loss could be reduced by one-half the efficiency would be increased 1 per cent., together with a considerable reduction in heating. The subject of stray losses in turbo-alternators was deserving of thorough investigation.

Dr. W. CRAMP said the author had shown that the first general limitation was the frequency, and the second was the material available. He cordially approved of the use of the term "yield point" instead of "elastic limit" throughout the paper, but there was no indication of what the author considered to be a safe stress with respect to a given yield point, *i.e.*, of the factor of safety employed. Another limit not mentioned in the paper beyond which any increase in peripheral speed might lead to uneconomical design was introduced by the fact that in a slotted rotor, when certain limiting densities were decided upon, there was a corresponding maximum slot area. The area of the slot multiplied by the space factor, by the specific weight of copper, by the square of the velocity, and divided by g R was a measure of the centrifugal force acting upon unit length of the tooth root. Equating this to the section of the tooth root multiplied by the safe stress corresponding to the material used would show whether the most economical design as dictated by electro-magnetic considerations was consistent with the peripheral speed and material proposed. He concluded that designers were approaching the limit when they would not have material which would carry the stress corresponding to the maximum copper which could be got into the slot. Regarding critical speed, he was quite in agreement with the author, but local designers did not take the same view. When he specified a turbo-alternator in which the critical speed was to be above the speed at which the machine ran, a well-known designer said there was no necessity for any such limit, as no one would pay for it. Presumably this attitude would now be abandoned. Regarding ventilation, the author showed preference for an axial passage under the winding slots with a radial discharge distributed over a fairly wide central portion of the rotor; many designers thought that pure axial ventilation was very much better when it could be accomplished. Regarding air-gap reluctance as affected by the stator slots, Mr. Carter's paper on "Airgap Induction" was a fine example of what might be carried out to a very much greater extent.

Mr. H. DUTTON, in a communication, described his experiences with some D.C. turbo-generators over a period of five years, and emphasised the necessity of perfect balancing at the operating speed. He deprecated short-circuiting tests, and pointed out that with step-up transformers between the generators and bus-bars, reactance coils appeared to be unnecessary.

The AUTHOR, in reply to Prof. Walker, said that the field winding described in the paper was not, in his opinion, the final solution of the problem; Prof. Walker's system had many advantages. A number of small slots were used, and by excellent cooling conditions a much shallower slot was permissible than in the system described in the paper. On the other hand, a number of small slots was a manufacturing disadvantage when dealing with heavy pieces. Mr. Kuyser's system of ventilation was interesting, but had the disadvantage of some blind-ended vents, with possible manufacturing difficulties. Mr. Kuyser had also referred to short-circuit tests on 2-pole 25-cycle machines; it was justifiable to take the risk of unbraced coils on 2-pole machines, but the risk appeared too great on 4-pole machines. Cases had occurred in which the shaft had been twisted, which gave some idea of the shock to the windings. In reply to Mr. Juhlin, ductility was required not at the thick part of the tooth, but at the root; wedges did not fit along their whole length, and at certain parts a tooth had to be stretched to throw the load upon another part, and so on. It was satisfactory to find steel makers in this country willing to accept orders subject to radial tests; steel makers in the States gave point-blank refusal. Bad joints in the rotor would show up by producing low critical speed. Outside slip-rings had many advantages, but the mechanical disadvantage of taking the leads through the shaft, in the author's opinion, more than counterbalanced the advantages. Regarding the costs, there was very little to choose between the solid and built-up rotor when complete. Replying to Mr. McKenzie, the author agreed that the advantages of air washing or filtration were enormous. Regarding hollow conductors, there were possibilities in the case of turbo-windings; many years ago such windings were used on transformers in the Niagara district, water circulation being used in the low-pressure windings. Some movement of rotor windings certainly did take place, but as it was slight it was easily taken care of; he did not consider this motion the cause of the breakdown referred to by Dr. Worrall. He agreed with Mr. Townend that the whole subject of short-circuit losses was greatly in need of investigation. In large machines the short-circuit losses were enormous, and their distribution was quite unknown. They were too big to be local, and were probably distributed all over the machine, otherwise the consequences would be more serious. In reply to Dr. Cramp regarding the factor of safety, the author said the machines were all tested at 20 per cent. over speed, and would hold together at 50 per cent. over speed. With reference to rotor slots, the tooth stresses were not a serious matter, since if they were a salient feature nickel steel could be used without any great increase in cost. Mr. Carter's work seemed to show that in general the question of air-gap reluctance would be accurately enough determined in these machines; the question of rotor face losses, however, was obscure, and Mr. Carter's work did not cover the case.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

18,047. "Manufacture of rigid pieces of metal insulated against electrolysis and corrosion." P. M. STEWART. December 28th. (Complete.)

18,049. "Electric fuses." V. HOFE. December 28th.

18,067. "Spark-plug holder or tester for internal-combustion engines." L. J. SOUHAMI. December 28th.

18,068. "Electric heating device." LANDIS & GYR, AKT. GES. December 28th. (Addition to and divided application on 15,685/15. Convention date, December 5th, 1914, Switzerland.) (Complete.)

18,069. "Electric heating device." LANDIS & GYR, AKT. GES. December 28th. (Addition to and divided application on 15,685/15. Convention date, February 16th, 1915, Switzerland.) (Complete.)

18,070. "Electric heating device." LANDIS & GYR, AKT. GES. December 28th. (Addition to and divided application on 15,685/15. Convention date, June 30th, 1915, Switzerland.) (Complete.)

18,084. "Telephone systems." H. S. TURNER. December 28th. (Divided application on 6,480/15, April 30th.) (Complete.)

18,103. "Filament winding machines." C. EISLER. December 28th. (Convention date, December 29th, 1914, U.S.A.) (Complete.)

18,114. "Method of electric welding." D. H. WILSON. December 29th. (Convention date, July 9th, 1915, U.S.A.) (Complete.)

18,115. "Alloy for arc welding." D. H. WILSON & S. M. RODGERS. December 29th. (Convention date, June 16th, 1915, U.S.A.) (Complete.)

18,137. "Dynamo-electric machines." S. H. MARTIN. December 29th. (Convention date January 2nd, 1915, U.S.A.) (Complete.)

18,166. "Electrical relays." S. G. BROWN. December 30th.

18,171. "Electric torches for pencils, pens, and the like." T. H. ESCOTT and A. ALLCOTT. December 30th.

18,189. "Alternating-current electromagnets." H. P. AMPHLETT. December 31st.

18,203. "Switch for eliminating dead-end effects in wireless receiving apparatus." C. S. LENZ. December 31st.

18,222. "Method for connecting carbon electrodes to one another." R. HADDAN (Soc. Francaise des Electrodes, France). December 31st. (Complete.)

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1914.

20,505. REGULATION OF ELECTRIC INSTALLATIONS COMPRISING ELECTRIC GENERATORS. Soc. Anon. des Etablissements L. Bleriot. October 3rd. (October 13th, 1913.)

22,609. REGULATING DEVICE APPLICABLE TO SELF-INDUCTION COILS OR TO WINDINGS OF TESLA TRANSFORMERS USED IN WIRELESS TELEGRAPHY OR OTHER APPLICATIONS OF HIGH FREQUENCY. L. Rouzet. November 16th.

23,938. PERMANENT MAGNETS FOR ELECTRIC METERS. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). December 11th.

24,074. TROLLEY POLES OR BOWS FOR ELECTRICALLY-PROPELLED VEHICLES. G. Meyer. December 15th.

24,169. ELECTRICAL MEASURING INSTRUMENTS OF THE THERMAL TYPE. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). December 16th.

24,238. GOVERNORS. British Thomson-Houston Co. & R. H. Collingham. December 17th.

24,335. ELECTRIC ARC LAMPS. G. A. Hughes. December 19th.

24,552. ELECTRICAL RESISTANCES. A. H. Curtis. December 23rd.

1915.

722. SAFETY DEVICES OR VACUUM RELAYS FOR ELECTRIC CIRCUITS. Siemens Schuckertwerke Ges. January 16th. (January 16th, 1914. Patent of addition not granted.)

760. WIRE, CABLE, AND ROD CUTTER. M. Parker (legal representative of J. Parker, deceased). January 18th.

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3,690. ELECTRIC IGNITING APPARATUS FOR GAS BURNERS. South Metropolitan Gas Co. & W. J. Buckett. March 8th.

5,371. MANUFACTURE OF ELECTRICAL CONDENSERS. Marconi's Wireless Telegraph Co. & C. Mitchell. April 9th.

5,969. THERMOSTATS. H. E. Moul. April 21st.

7,607. ARMOURING FOR SIMPLE-CORE ELECTRIC CABLES FOR ALTERNATING CURRENTS. A. Rosselli. May 20th.

8,449. ELECTRIC RIVET-HEATERS, WELDERS, AND THE LIKE. E. F. Giraud. June 7th. (June 20th, 1914.)

13,618. INSULATING AIR-TIGHT JOINTS FOR TERMINALS OF VAPOUR ELECTRIC APPARATUS. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co.). September 24th.

15,083. PORTABLE ELECTRIC LAMPS. H. J. C. Forrester (J. W. Dunham). (Divided application on 2,489/15, February 16th.) October 25th.

A Contemporary's Diamond Jubilee. — With its last issue for 1915 our contemporary, the *Engineer*, completed its sixtieth year of publication. Congratulations!